

FIELDBOOK
OF
NATURAL HISTORY

FIELDBOOK OF NATURAL HISTORY

By E. LAURENCE PALMER

*Professor of Nature and Science Education
Cornell University
Director of Nature Education
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FIELDBOOK OF NATURAL HISTORY

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*This book is dedicated to
the memory of my son Laurence Van Winkle Palmer
and to
the future of my son Richard Robin Palmer*

Preface

History, education, economics, and similar increasingly popular social sciences have on occasion shown us the error of our ways. They have defined problems that we must face in our increasingly complex civilization. Science has provided us with facts that may be used in solving these problems, and engineering and management have suggested ways of using these facts effectively. There has sometimes been a superficial conceit in the social sciences, an academic bigotry in the natural and physical sciences, and an impersonal, mechanistic routine in the technical fields that have failed to help the layman and beginning student use his immediate material environment in meeting the practical problems of the day. Much of the literature available to the average person has become too technical, too highly specialized to serve a practical purpose to him. It is to help meet this situation that this book has been written. It is hoped that this combination of philosophy, facts, and techniques may help us all enjoy doing what must be done, when it must be done wherever we may be. This should lead to a sound citizenship, a rational conservation policy, and a happy life.

During the more than a decade that has been devoted to its actual preparation, a number of changes have taken place that bear on the nature of the book. At one time it was thought best to confine the content to biological matters, but there seemed to be a need for a book that would also give information on the stars, rocks, and minerals. The restrictions imposed by meeting this need have eliminated some two hundred plants and animals on which the material had already been prepared as well as a section on historic geology and on galls.

This book is not a textbook in botany, zoology, geology, or astronomy in the strictest sense. Nor is it a manual for the identification of most of the objects considered in those sciences. Students with special interests in those fields will no doubt find superior offerings elsewhere of a more comprehensive nature. However, few books on plants and animals seem to recognize that a cow is an animal or corn is a plant, and most of them ignore the existence of familiar domesticated species. The author has included some domesticated and economic forms, in spite of the advice of his publisher, because it is his belief that people want to know about cows, corn, cod, and chickens. In general, he has attempted to choose those things found most commonly in an unmodified or still identifiable form in the field, stream, or wood lot, in the grocery or fruit store, or behind the kitchen sink.

There will be many who will disagree with some of the selections for inclusion in the book. To these persons the author may only say that were he to rewrite the book he might make inclusions and rejections similar to those they have in mind.

The forms here included, or rejected in spite of their preparation, represent to the author the things that have most interested him, his students, and his friends in more than a third of a century of teaching field natural history from New England to Hawaii.

Throughout the book wherever appropriate a uniform treatment has been followed of presenting a picture and description for identification supplemented by data on range and relationships, life history, ecology, and economic importance.

Technical terms have been avoided wherever simpler language was adequate. Generally, line drawings have been used because they offer superior opportunity for emphasis of distinctive characters.

Occasionally, to increase the number of kinds of things considered, two or more species have been listed in the descriptive columns. In these cases the names have been given numbers, which have been repeated where significant in the printed material below.

In summary, the author has endeavored to write the kind of book he would have liked to have had available when he began the study of natural history as a youngster, as well as a book he can use now and in his old age to add the research and experience of others to what he may see for himself in his experiences with natural history. It is his earnest desire that the book may offer an equal appeal to you.

E. LAURENCE PALMER

ITHACA, N. Y.
January, 1949

Acknowledgments

In the preparation of encyclopedic material such as is found in this book, one of the major regrets is that space forbids a just documentation of all the sources of inspiration and information that have been called upon knowingly or otherwise. Since the author has lived a year in the tropics, a year on the Pacific Coast, some years in the Middle West, and many years in the East and South, it is difficult for him to know in some instances just what is the source of this or that bit of information. To all his named and unnamed collaborators, therefore, the author acknowledges a debt of gratitude. Except for the marine species in part, the author has had personal field or zoo experience with almost all the creatures here considered. Without apology he has naturally called upon these experiences in writing this book.

However, certain sources have been of such direct assistance that the author wishes to acknowledge his indebtedness. Roughly, these are those who have given actual information, those who have provided the illustrations, those who have reviewed the manuscript, those who have consented to its preparation in connection with regular professional duties, and those who have helped prepare the manuscript for the printed form.

The publications of the Federal and state governments have been drawn upon freely in providing material supplementary to that based on personal experience. Particularly helpful have been the bulletins of the United States Department of Agriculture and the various services interested in natural resources, the bulletins of the various state colleges of agriculture and of forestry, as well as various state surveys in the field of natural history. Professional journals have also provided many useful data. The major journals of each of the fields of interest here considered have been consulted freely in the preparation of this material.

Lectures in colleges and at professional meetings have added a surprising volume of material. The extent to which standard texts have been directly or indirectly involved is naturally difficult to determine.

At the beginning, it was hoped to limit the illustrations to the work of three artists, but this plan was of necessity altered. However, the major work in each of the original fields agreed upon represents the efforts of three young women who began the work in 1936. Practically all the drawings of plants are from the pen of Mrs. Elizabeth Burckmyer, who has stayed with the project from beginning to end. Most of the drawings of vertebrates were made by M. Hope Sawyer, daughter of Edmund Sawyer, the bird artist. The excellent drawings of invertebrates begun by Velma Knox were continued by Mae Geiger. Unfortunately, it was not possible for these two artists to complete their section. It became possible through purchase to use many of the drawings of birds and mammals made by the late Louis Agassiz Fuertes and some of the drawings of plants by the late Mary Eaton. Other artists represented in these pages, in the order of the amount of work done, include Clara Garrett, who did some of the work on birds, C. M. Reilley, Jr., and

Heinz Meng, who drew some of the illustrations of invertebrates, and Stephen Collins, who made six of the drawings of mammals. A few drawings in each category have been made by the author. Credit is gladly given Dr. Leon Hausman for permission to use his drawings representing the character of hairs. Photographs of the marine shells are by the author's wife, Dr. Katherine Van Winkle Palmer, who also made approximately half of the photographs of rocks and minerals. The remainder of the rock and mineral photographs were produced with the cooperation of Ward's Natural Science Establishment of Rochester, New York, who have extensive files in this field. Without the cooperation of all these persons this book could not have been completed. Their help is gladly acknowledged.

Criticisms of prepared material before a book appears are of inestimable value to an author, and it is hoped that through careful survey errors in this book have been reduced to a minimum. The various sections have had the benefit of the criticism and comment of many of the author's associates, as follows:

Astronomy, Prof. S. L. Boothroyd

Rocks and Minerals, Prof. W. Storrs Cole

Fungi, Prof. H. H. Whetzel

Flowering-plant Nomenclature, Prof. R. T. Clausen

Mollusks, Dr. Katherine V. Palmer

Other Invertebrates, Profs. J. D. Hood, W. T. M. Forbes, and J. C. Bradley

Fish, Prof. E. C. Raney

Amphibians and Reptiles, Prof. A. H. Wright

Birds, Prof. A. A. Allen

Wild Mammals, Prof. W. J. Hamilton, Jr.

Domestic Mammals, Profs. E. S. Savage and G. W. Salisbury

Acknowledgment is due the administration of the New York State College of Agriculture at Cornell University for permission to undertake the book while regularly employed by the institution and for use of material originally published in the Cornell Rural School Leaflet. Much of the material is rewritten from special inserts that have appeared in *Nature Magazine*, of which the author has been Nature Education Director since 1925. Permission to use this material and the helpful criticisms of readers of *Nature Magazine* have molded the nature of the book considerably. This cooperation has been thoroughly appreciated.

The author's wife, Dr. Katherine Van Winkle Palmer, has helped see the material through the pains of publication and has been most charitable in giving priority to the book when legitimate demands on his time existed.

For the kindly cooperation of all who have been identified in any way with the project thanks are gladly given.

Fieldbook of Natural History

Introduction

A preview of the contents of this book will show that it has some bearing on each of the major fields with which natural history deals: the universe itself, our solar system, the earth and the rocks, minerals, plants, and animals represented in practically any normal environment in which man lives.

As a preliminary guide, a synopsis of the major groups covered is presented here in the hope that it may indicate the scope of the book and be a convenience in finding the different groups quickly. Information needed to use the major sections is provided in the initial treatment of each section.

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The Sky at Night

On p. 5 there is a general map of the stars one might see at any time of the year in the temperate parts of the Northern Hemisphere either with the naked eye or with a low-power glass.

To use this map most effectively, trace or cut out the frame shown on p. 3. Then cut out the indicated portion on the frame. Now place the frame over the map in such a way that the proper date is adjacent to the hour when the observations are to be made. The stars and the map and the horizons should now be oriented.

After you have become acquainted with the major stars and constellations with the aid of this map, you will probably wish to know more about some of them. The maps on pp. 6-15 will help you. Charts III-X are continuations of the areas adjacent to the margins of Charts I and II as indicated. With these maps, you may learn interesting facts, not myths, about most of the stars you can see in the sky above you at night.

In reading about these stars in the text that accompanies each map, you may find some confusing terms. For example, you find that the North Star, Polaris, Star 43, Chart I is a triple star, with certain distances, certain magnitudes and periods. This means that what you see as a point of light as Polaris is really 3 stars. You learn that it is at a distance of 190 light-years, which means that it took light 190 years to reach the earth from this group. Since light travels at the rate of 186,000 miles a second, or about 6 million million miles in a year, we find it easier to speak of the distance in terms of *light-years* than in actual miles. If you wish to get an approximation in miles you may do so by multiplying the designated light-years by about 6 million million. You will soon give up this bit of mathematics as unnecessary.

The brilliance of stars is spoken of as the *magnitude*. In speaking of stars magnitude does *not* mean size. The smaller the number given to indicate magnitude, the brighter is the star. First-magnitude stars are the brightest, and stars with a magnitude of 9 or more cannot be seen by the naked eye. The most brilliant stars have a magnitude greater than 1 and are therefore spoken of as having a minus magnitude. Sirius, for example, has a magnitude of -1.6 .

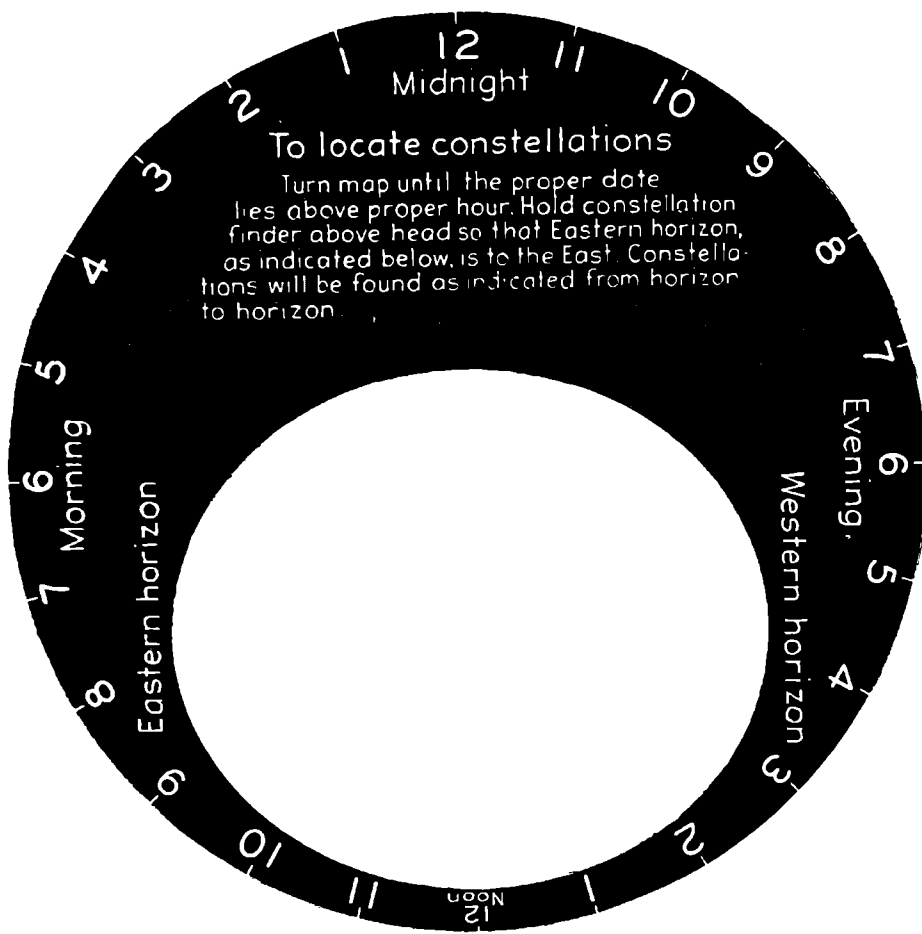
When we say that a star is *variable*, we mean a number of things but chiefly we refer to variation in brilliance. This may have several causes.

The term *period* is used to indicate the time required for one star to complete a revolution around another.

Constellations are rather arbitrarily accepted groups of stars. Some of the major stars of the constellations are connected by dotted lines in the maps.

Planets of course are not stars and cannot be found in these maps. The nature of the planets is given in the table on pp. 18-20 but their position cannot be indicated here. With the help of the constellations you can locate with these maps, a good almanac should assist you in recognizing the more conspicuous planets to be found at different times.

Since it is probable that you may wish to locate a star whose name you have heard, a directory of the stars considered in these maps follows. In the directory, IX, 15 means that the star is Star 15 on Map IX. This book is not concerned with the myths about the stars or constellations.



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Alpheratz, III, 12	Canis Major, V
Altair, IX, 29	Canis Minor, V
Andromeda, III, X	Canes Venatici, VII
Antares, VIII, 35	Capella, IV, 1
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Aquila, IX	Cassiopeia, I, II, III
Archer, IX	Castor, V, 1
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Aries, III	Cetus, III
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 Unicorn, V
 Ursa Major, I, II, VI
 Ursa Minor, I, II
 Vega, IX, I
 Virgo, VI, VII
 Vulpecula, IX
 Whale, III

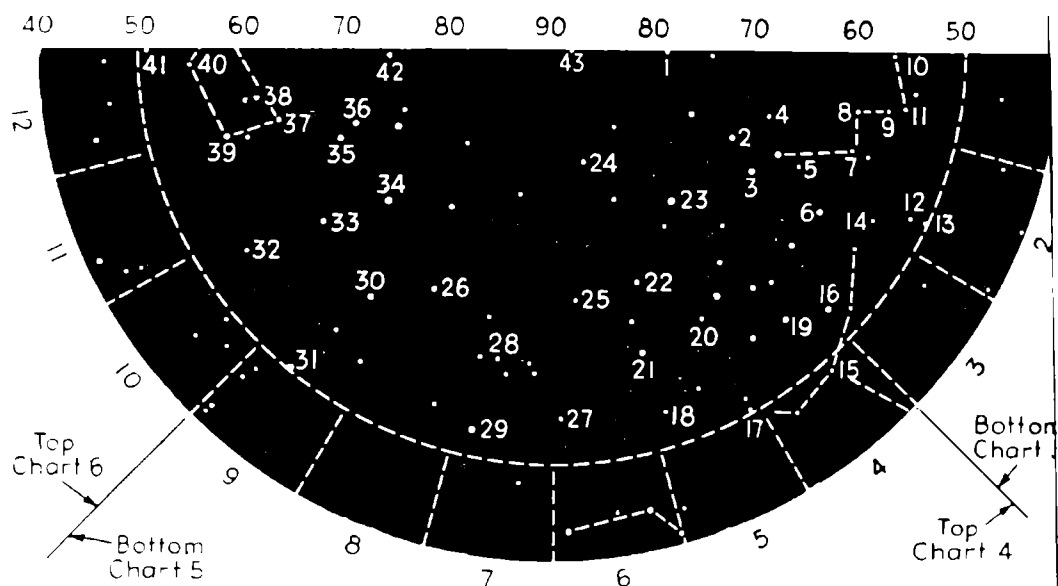


CHART I
POLAR CONSTELLATION CHART

Cepheus. Star 1, period 166.2 years.

Cassiopeia. Star 2, double, magnitudes 4.7, 7.2; period 52.95 years; Star 3, triple, magnitudes 4.7, 7.1, 8.1; Star 4, triple, magnitudes 4.4, 8.9, 9.5; Star 5, magnitude 3.4; Star 6, gold-green, double, magnitudes 6.1, 6.6; Star 7, magnitude 2.8; Star 8, magnitude 2.2; Star 9, gold-red, double, magnitudes 3.7, 7.9; period 507.6 years; Star 10, magnitude 2.4; distance 5.7 light-years; Star 11, Shedir, variable, magnitudes 3.6-7.9; distance 47 light-years.

Perses. Star 12, double spiral nebula joined with a ring; Star 13, double; periods 126.5 days, 63.2 days; Star 14, double, variable, magnitudes 7.5-11 and 8; period 320 days; Star 15, Mirfak, magnitude 1.9; period 4.09 days; Star 16, magnitude 3.1; Star 17, magnitude 4.5; period 1.5 days.

Camelopardus, the Giraffe. Star 18, double, magnitudes 4.4, 11.3; period 3.8 days; Star 19, double, magnitudes 4.8, 9.2; Star 20, nebula; Star 21, magnitude 4.7; Star 22, magnitude 4.3; period 7.9 days; Star 23, magnitude 4.7; Star 24, double, magnitudes 4.5, 8; Star 25, triple, magnitudes 6.7, 7.9, 10; Star 26, triple, magnitudes 6.2, 8, 9.2.

Auriga. Star 27, magnitude 2.1.

Lynx. Star 28, triple, magnitudes 5.2, 6.1, 7.4; Star 29, variable, magnitudes 7-13.8; variation period 379.2 days.

Ursa Major, the Great Bear. Star 30, magnitude 3.5; Star 31, variable, magnitudes 8.4 to 13; period 247 days; Star 32, double, magnitudes 5, 5.6; period 99.7 years; Star 33, double, magnitudes 3.8, 9; Star 34, double, magnitudes 5, 8; Star 35, magnitude 4.9; period 11.58 days; Star 36, variable, magnitudes 7-13; variation period 302 days; Star 37, Dubhe, magnitude 2; distance 70 light-years; Star 38, double, magnitudes 5.8, 7.1; period 71.9 years; Star 39, magnitude 2.4; period 0.31 days; distance 60 light-years; Star 40, magnitude 2.5; Star 41, spiral nebula.

Draco, the Dragon. Star 42, double, magnitudes 7, 8.3; period 42 years.

Ursa Minor, the Small Bear. The polestar, Polaris, 43. This is really a triple star. The major group has a magnitude of 2.1, is yellow, is 190 light-years distant and is 1,000 times as brilliant as our sun. Two of the units turn around each other in a period of 3.96 days, and these in turn move about the third in a period of 11.9 years. Another unit has a magnitude of 9.

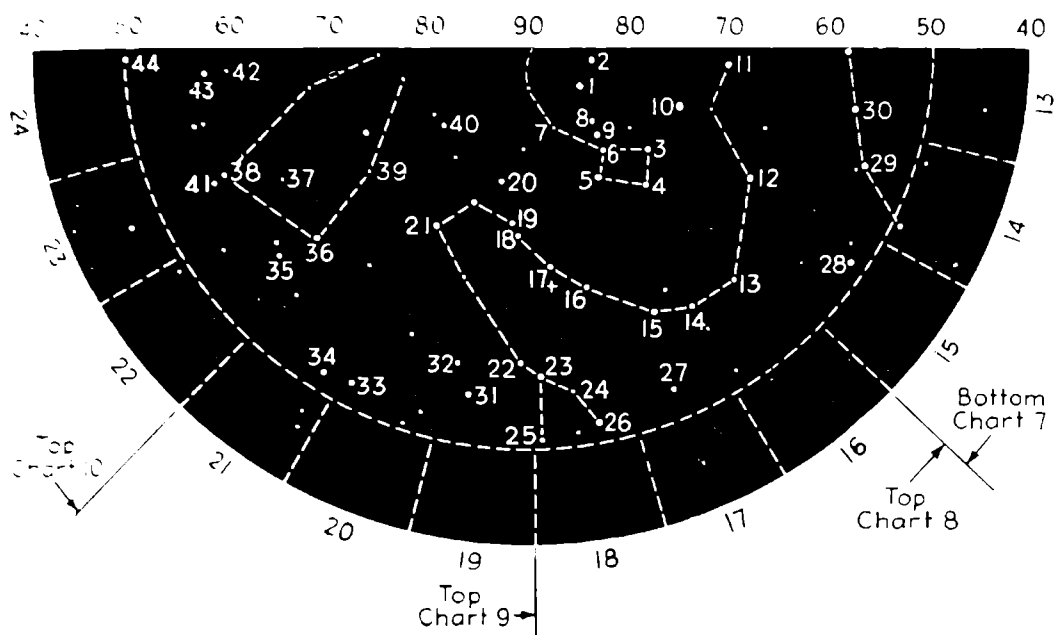


CHART II

Camelopardalis, the Giraffe. Star 1, variable, magnitudes 7.9–13.7; variation period 269.5 days; Star 2, double, magnitudes 5, 6.

Ursa Minor, the Small Bear. Star 3, Kochab, the polestar in A.D. 140; magnitude 2.2; distance, 230 light-years. Stars 4, 5, 6, parts of the Little Dipper; Star 7, magnitude 4.4; period 39.5 days; Star 8, double, magnitudes 7, 8; variation period 115 years; Stars 9 and 10 variable, magnitudes over 7.

Draco, the Dragon. Star 11, magnitude 3.9; Star 12, Thuban, magnitude 3.64; period 51.38 days; the polestar when pyramids were built more than 5,000 years ago; Star 13, magnitude 3.5; Star 14, triple, magnitudes 7.5, 7.7, 9; Star 15, double, magnitudes 2.9, 8.1; Star 16, magnitude 3.2; Star 17, magnitude 4.87; period 5.28 days (the pole of the ecliptic is indicated by a cross almost south of this star); Star 18, double, magnitudes 4.8, 6.5; Star 19, magnitude 3.6; period 281.8 days; Star 20, period 4.12 days; Star 21, double, magnitudes 4, 7.6; Star 22, triple, magnitudes 4.7, 7.7, 7; Star 23, variable, magnitudes 7.5–12.2; variation period 426 days; Star 24, double, magnitudes 4.6, 4.6; Star 25, magnitude 2.5; distance 74 light-years; Star 26, double, magnitudes 5, 5.1; Star 27, double, magnitudes 5, 6.

Bootes, the Herdsman. Star 28, double, magnitudes 4, 12.

Ursa Major, the Great Bear. Star 29, Mizar, the first double discovered, magnitudes 2.1, 4.2; period 20.25 days; distance, 80 light-years; Star 30, magnitude 1.68; 56 light-years away; period 4.15 years.

Cygnus, the Swan. Star 31, double, magnitudes 5, 9; Star 32, double, magnitudes 6.8, 7.4; Star 33, variable, magnitudes 15–1.9 in 10 days; Star 34, triple, magnitudes 7, 9, 10.1.

Cepheus. Star 35, triple, magnitudes 6.3, 7.9, 8; Star 36, magnitude 2.6; distance 36 light-years; Star 37, double, magnitudes 4.7, 6.5; Star 38, variable, magnitudes 3.6–4.3; variation period 5 days 8 hours 48 minutes; Star 39, double, magnitudes 3, 7; period 0.19 days; Star 40, variable, magnitudes 7.0–12; variation period 486 days; Star 41, double, magnitudes 9.3, 10.8; period 54.9 years; distance, 12.6 light-years.

Carina, the Whale. Star 42, triple, magnitudes 7, 8.5, 9; Star 43, quadruple, magnitudes 4.8, 10, 7.4, 8.9; period 6 days; Star 44, variable, magnitudes 5.3–12.7; variation period 431.6 days.

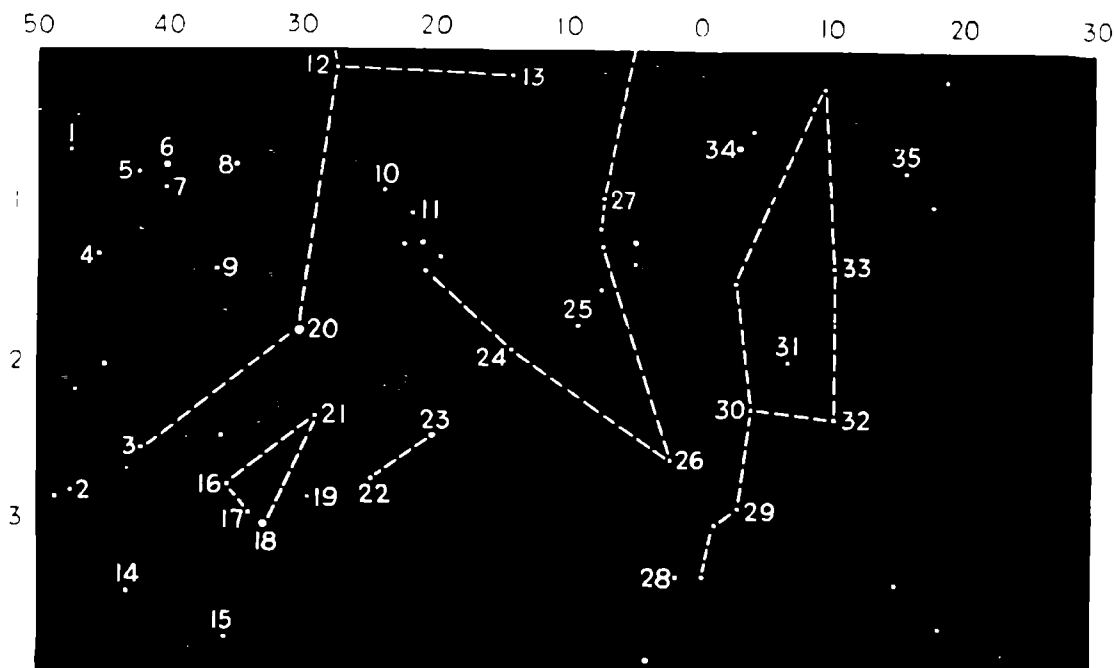


CHART III

Constellation *Cassiopeia*, Star 1, magnitude 5.02, period 1.7 days.

Stars 2 to 12 are in the constellation *Andromeda*. Star 2, double, magnitudes 6.4, 7.3; period 204.7 years. Star 3, double, magnitudes 2.3, 5.4, is a cerulean blue and gold star with a period of 55 years. Star 4, double, magnitudes 4.9, 6.5, is made of two blazing suns. Star 5 is an oval pearl-white nebula. Star 6 is a great spiral nebula and the nearest of the spiral nebulae to the earth. It is 900,000 light-years distant and 50,000 light-years in diameter. On a reasonable assumption, it takes about 17 million years for it to complete a single revolution and it produces $1\frac{1}{2}$ billion times the light produced by our sun. It has a mass of the order of 1 billion times the mass of our sun. Star 7 has a magnitude of 4.4 and a period of 4.28 days. Star 8, double, magnitudes 6, 9, has a period of 143.7 days; Star 9, magnitude 2.4; Star 10, magnitude 4.3; period 17.76 days; Star 11, double, magnitudes 6.1, 6.7; period 109.07 years. Star 12, Alpheratz, has a magnitude of 2.2 and a period of 96.67 days. Its temperature is about 11,000 C.

Star 13, Algenib, in the constellation *Pegasus*, has a magnitude of 2.9. One side of the Great Square of Pegasus is limited by these last two stars.

Pegasus, Star 14, a beautiful cluster 20,000 light-years distant; Star 15, a double, magnitudes 5.6, 6.7; period 33.3 years.

The constellation *Triangulum* includes a number of interesting stars. Stars 16, 17, and 18 are almost in line and have magnitudes of 3.1, 5, and 4, respectively. Star 19, double, magnitudes 5.6, 6.4, is sapphire-gold. Star 20 is a nebula 900,000 light-years away with a period of 160,000 years. Star 21 has a magnitude of 3.5 and a period of 1.7 days.

In the constellation *Aries*, Star 22, Hamal, the Shepherd's Star, magnitude 2.2; Star 23, magnitude 2.7; period 107 days.

Stars 24, 25, 26, and 27 are in *Pisces*.

The constellation *Cetus, the Whale*, includes at least eight interesting stars. Star 28 is a double, magnitudes 3, 6.8. Star 29 is Mira, whose magnitude varies from 1.7-9.6. It has a variation period of 332 days and is 165 light-years distant. It is a globe of gas 250 million miles in diameter and about 300 times the size of our sun. Star 30 is a dark nebula. Star 31, a nebula, is moving through space at the velocity of 1.240 miles a second. Star 32 is a dark nebula. Star 33 has a magnitude of 4. Star 34 is a double, magnitudes 5.2, 6.4; period 6.88 years. Star 35 has a magnitude of 2.2.

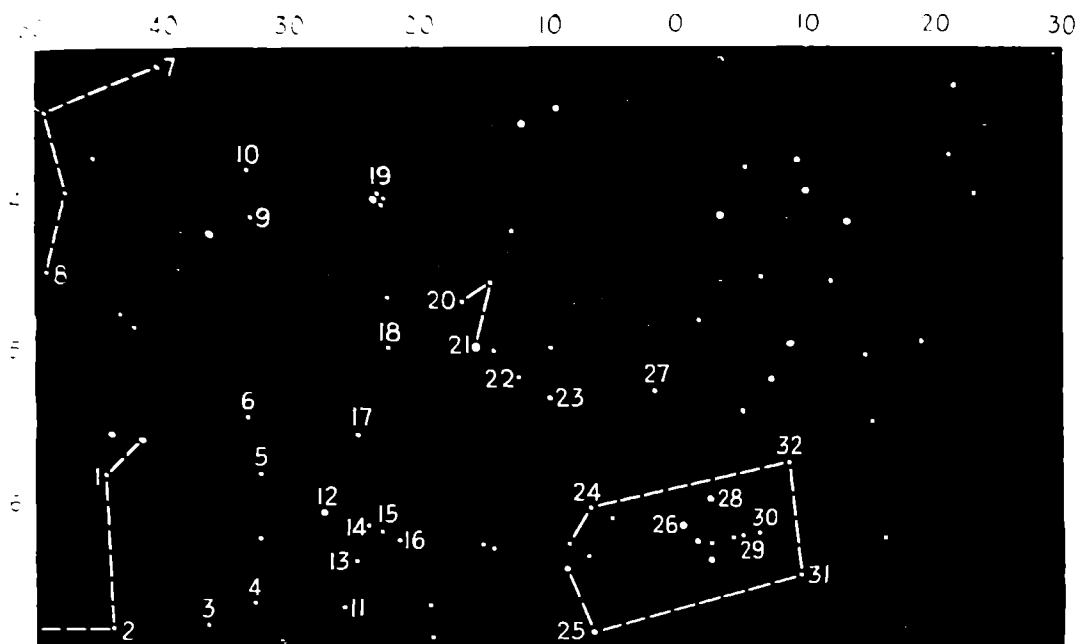


CHART IV

Capella, Star 1, is the most conspicuous one in *Auriga*. Its magnitude is 0.21; period 104 days. It is 151 times as bright as the sun, has a surface temperature of 10,400°F., and is 47 light-years distant. Star 2, magnitude 2.7; period 3.96 days; mass, 17 times that of the sun; Star 3, magnitude 5.3; period 15.1 days. Star 4 is a mass of 20,000 stars. Star 5, triple. Star 6 is a large sun, magnitude 2.9.

Perseus, Algor. Star 7, the Ghoul, or Demon Star; magnitude 2.2-3.2; period 2.87 days; mass, 4 times that of the sun; 160 times as bright as the sun. Stars 8, 9, and 10, periods of 284, 6.9, and 4.4 days, respectively.

Taurus, *the Bull*, is always interesting. *The Pleiades* and the star Aldebaran are the most important. Star 11, magnitude 4.5; period 5.9 days; Star 12, magnitude 1.8; Star 13, magnitude 5; period 27.8 days; Star 14, double, magnitudes 5.8, 6.6; blue-white; Star 15, "crab nebula"; Star 16, magnitude 3; period 135 days; Star 17, a nebular cluster; Star 18, double, magnitudes 4.3, 7.2; period 15 days. Aldebaran, Star 19, a star in the Pleiades, has a magnitude of 3 and is millions of miles in diameter. The cluster is made of over 500 giant suns and is 30 light-years in diameter. The volume of each of the 5 brightest stars of the cluster is at least 800 times that of the sun. The cluster is 325 light-years distant, or 12½ times more remote than *the Hyades*. Star 20, magnitude 5.6; period 8.4 days. Aldebaran, Star 21, the "eye" of the Bull, the Hyades, magnitude 1.1, has a diameter of 40 million miles.

Orion, *the Hunter*. Stars 22 and 23, periods 56 and 16.61 years; Bellatrix, Star 24, the Female Warrior, magnitude 1.7; Betelgeuse, Star 25, magnitude 0.9; period 6 years; surface temperature 6750°F.; 1,296 times as bright as the sun. Its volume is 27 million times and its diameter 300 times that of the sun. It is 192 light-years distant and has an average density of about 1/1000 of an atmosphere. Star 26, greenish; double, magnitudes 2, 6.8; period 5.7 days; Star 27, magnitude 3.8; period 17 days; Star 28, double, magnitudes 3.4, 5; period 8 days; Star 29, a great nebula; 650 light-years distant; diameter 5 or 6 light-years, or 30 or 40 million million miles. It is so rare that if the air left in the supposed vacuum of an electric light globe were expanded to the size of our capitol at Washington, it would approximate the condition prevailing there. Star 30, double nebula, magnitudes 2.8, 7.3; period 29 days; Star 31, Saiph, magnitude 2.2; Star 32, Rigel, magnitude 0.3; distance 543 light-years; blue-white; 18,000 times as bright as our sun; temperature 28,800°F.

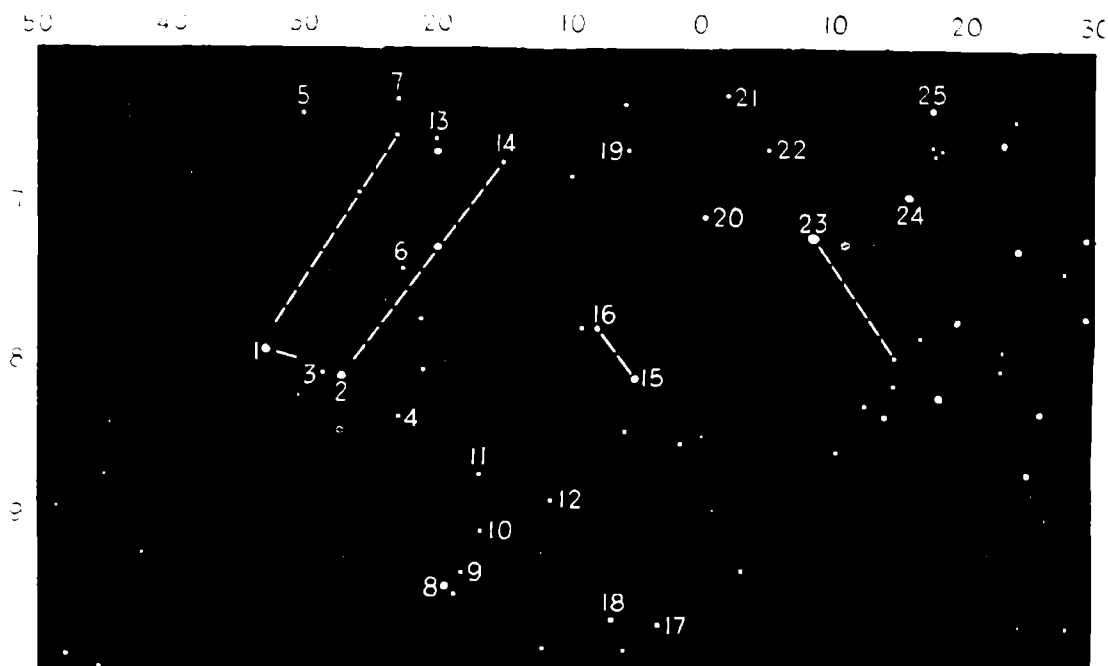


CHART V

The constellation *Gemini* is responsible for the expression, "By Jiminy." Castor, Star 1, is an important double star, magnitudes 2, 2.8, each part six times as brilliant as the sun would be at an equal distance; orange-blue; 42 light-years distant; period 306 years. Pollux, Star 2, the other of the "twins," magnitude 1.2; diameter 14 million miles; 33 light-years distant; Star 3, magnitude 1.6; period 19.6 days; Star 4, variable, magnitudes 8-13; variation period 288 days; Stars 5 and 6, barely visible; Star 7, variable, magnitudes 3.2-4; variation period 231 days.

The cluster Praesepe, Star 8, 363 suns; often referred to as a "beehive." The units vary in magnitude from 6-12, there being 173 in the main cluster. The cluster is about 600 light-years distant. Star 9, variable, magnitudes 8.4 to over 14; variation period 305 days; Star 10, variable, magnitudes 7.5-13; variation period 256 days; Star 11, double, magnitudes 5.3, 6.3; period 60 years; Star 12, variable, magnitudes 6-11.3; variation period 362 days; Star 13, magnitude 1.1; period 131 days; Alhena, Star 14, the "Circlet," magnitude 1.9; period 2,175 days.

Procyon, Star 15, is the major star in the constellation of *Canis Minor*, or the *Little Dog*. It is 10.6 light-years distant; $5\frac{1}{2}$ times as bright as the sun; pale topaz color; surface temperature 14,400 F. Except for Sirius, it is the closest to the earth of the larger stars. It is a double, magnitudes 5, 13.5. Star 16, variable, magnitudes 7.5-13.

Star 17 is in the constellation *Hydra* and has a period of 256 days. Star 18, double, magnitudes 3.7, 5.2; period 15.3 years; distance 135 light-years; mass $3\frac{1}{2}$ times the sun.

The constellation *Monoceros*, the *Unicorn*, includes stars 19 to 23. Star 19 is a cluster; Star 20 a very bright cluster, magnitude 6. Star 21, variable, magnitudes 7.2-12.9; variation period 332 days. Star 22, double, with masses 86 and 72 times (?) that of the sun. The magnitude is 6.6, the period 14.4 days, and the distance 10,000 light-years. Star 23 is a cluster with a ruby-colored star in the center.

The constellation *Canis Major*, or *Great Dog*, is conspicuous because of Star 24, Sirius, the *Scorcher*. This star is a double, magnitudes -1.6, 8.5; period 49.3 years; distance 8.9 light-years; 30 times as bright as the sun; mass 3.4 times that of the sun; surface temperature 19,800°F.; weight, on the average 1 ton for every cubic inch. Star 25 has a magnitude of 1.9 and a period of 6 years.

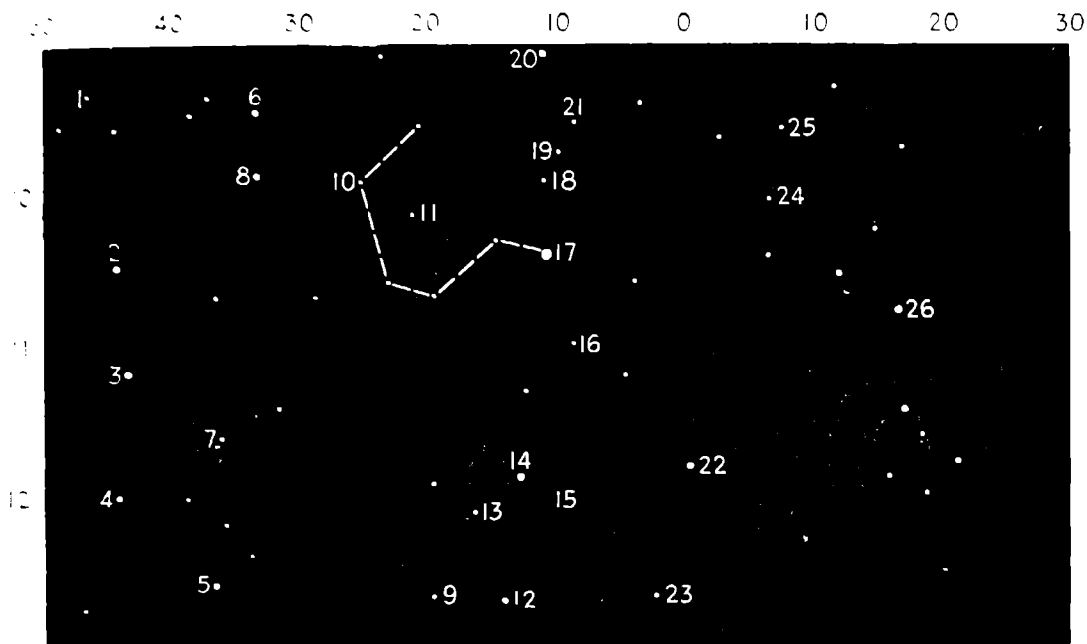


CHART VI

Star 6, in the constellation of *the Great Bear*, extends into the area here represented and includes stars 1 to 5. Star 1, magnitude 5.7; period 15.98 days; Star 2, magnitude 3.5; Star 3, magnitude 4.8; period 115.8 days; Star 4, magnitude 6.6; a large, oblong nebula. Star 5 is known as the Runaway Star. Its velocity through space is such that every two minutes it moves a distance equal to the path of the moon about our earth. No other known star has such a velocity. In spite of this terrific speed, it apparently moves but the breadth of the moon in 300 years. This is because of its great distance from us, 21.7 light-years.

Star 6, in the constellation *Lynx*, has a magnitude of 3.3.

The constellation *Leo Minor* contains stars 7 and 8; Star 7, magnitude 7.6; distance 7.9 light-years; Star 8, variable, magnitudes 7-13; variation period 370.5 days. The constellation *Leo* has as its most interesting star Regulus. Star 9, double, magnitudes 4.5, 8.4; period 71.7 days; Star 10, magnitude 5.1; Star 11, variable, magnitudes 8.6-13; variation period 273.1 days. Star 12 is Denebola, a star of 2.1 magnitude which is 25 light-years distant from the earth. Star 13 is a luminous nebula and Star 14 is a spiral nebula. Star 15, double, magnitudes 4, 7, shines with an amber-turquoise color. Star 16, magnitude 5.8; period 12.3 days. Regulus, Star 17, double, magnitudes 1.3, 8.4, the chief star in the constellation, is 72.4 light-years from the earth. It has a diameter of 3 million miles and is therefore about $3\frac{1}{2}$ times as great in diameter as our sun. Regulus appears as a jewel in the handle of a sickle outlined by about six stars. It lies almost exactly on the ecliptic, or the path made by the sun across the sky. It forms one angle of a conspicuous triangle, the other angles being at the stars Procyon and Pollux. Regulus appears conspicuously white. Star 18, also in the constellation Leo, is a variable star, magnitudes 4.6-10.5; variation period 312.8 days. Star 19, magnitude 3.7; period 14.9 days.

Stars 20 and 21 are in the constellation *Cancer, the Crab*. Star 20 has a magnitude of 5.1 and a period of 6.39 days; Star 21, double.

Star 22 is an oval nebula with a star center in the constellation *Leo*; Star 23 in the constellation *Ursa* has a magnitude of 3.8. This area has more nebulae than any other similar area in the heavens. Star 24, in the constellation *Sextans*, double, magnitudes 5.8, 6.1; period 72.76 years; Star 25, in the constellation *Hydra*, magnitude 2.2; distance 226 light-years. Star 26 is an elliptic, pale, steel-blue nebula.

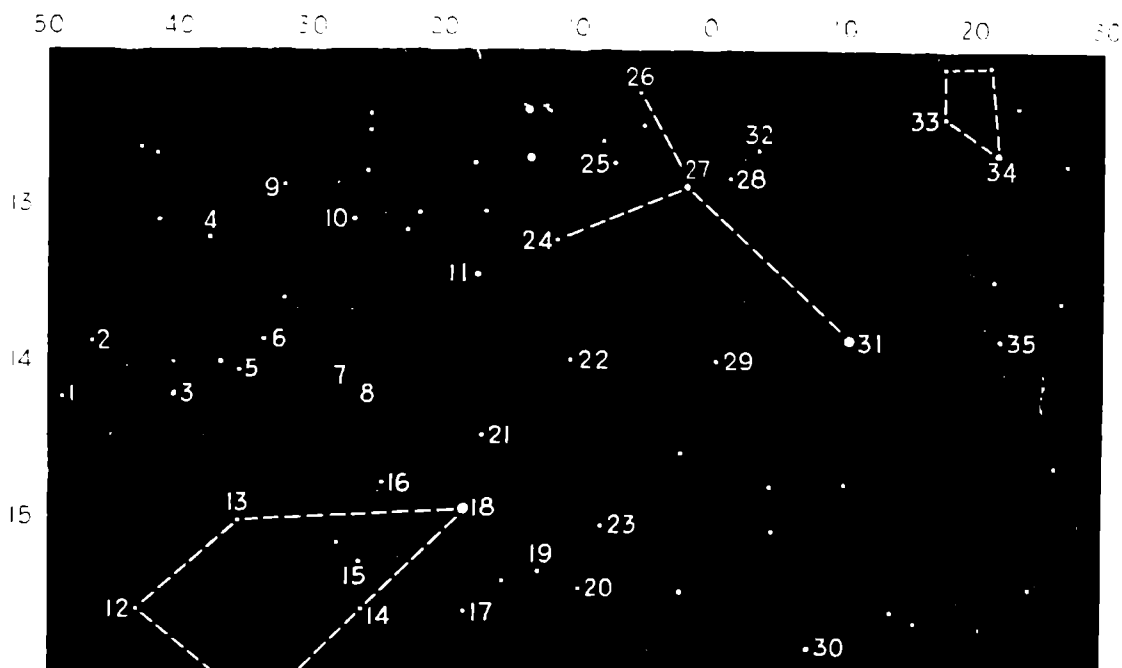


CHART VII

Coma Venatici. Star 1, Alcaid, has a magnitude of 1.9 and is 108 light-years distant. Star 2, spiral nebula of enormous size, occupies a space equal to 20 million times the orbit of Neptune about the sun; though whirling incredibly fast, it takes over 45 million years to make one revolution. Star 3, variable, magnitudes 6.1 to 12.7; variation period 326 days; Star 4, Cor Coroli, double, magnitudes 2.9, 5.7; period 5.5 days; Star 5, double, magnitudes 5, 5.8; period 220 years; Star 6, double, magnitudes 7.2, 7.7; period 48 years; Star 7, a globular cluster visible with the unaided eye on a clear night; composed of several hundred thousand suns; 60,000 light-years distant from the earth. This distance is so great that were our sun magnified twice and placed in the center of this cluster, it would be too small to be visible on a photographic plate. It requires light 65 years to cross its angular diameter. Star 8, double, magnitudes 7.6, 8; period, 199 years.

Coma Berenices. Stars 9, 10, and 11 barely visible.

Bootes, the Hunter. Star 12, double, magnitudes 7.5, 8; period, 97.93 years; Star 13, magnitude 4.83; period, 211.95 days; Star 14, double, magnitudes, 4.8, 6.4; period, 159.54 days; Star 15, variable, magnitudes, 6.6 to 12.9; variation period, 223.3 days; Star 16, double, magnitudes, 4, 8; period, 9.6 days; Star 17, double, magnitudes, 4.8, 6.4; variation period, 159.54 years; Star 18, Arcturus, magnitude, 0.2; diameter, 21 million miles, or $2\frac{1}{2}$ times that of the sun; 40 light-years distant; 15,000 as dense as water. From Arcturus to the handle of the Big Dipper is 40° . Star 19, double, magnitudes 4.4, 4.8; period, 130 years; Star 20, double, magnitudes 7.8, 8.8; period, 238 years; Star 21, double, magnitudes 2, 8; period, 497.1 days; Star 22, double, magnitudes 6.3, 6.3; period, 23 years; Star 23, double, magnitudes 5.5, 6.8.

Virgo, the Virgin. Star 24, magnitude 3; Star 25, variable, magnitudes 6.4-12.1; variation period 145.47 days; Star 26, variable, magnitudes 8.7-13.5; variation period 339 days; Star 27, variable, magnitudes 8-12; variation period 438 days; Star 28, double, magnitudes 3.6, 3.7; period 182.3 years; Star 29, magnitude 3.4; Star 30, variable, magnitudes 4.8-6.2; variation period 2,327 days. This star has an eclipse whose duration is 13 hours. Star 31, Spica, magnitude 1.2; white; period 4.01 days; 227 light-years distant from the earth; Star 32, double, magnitudes 8.6, 14.5; period, 218.8 days.

Corvus, the Crow. Stars 33 and 34, in *Hydra*.

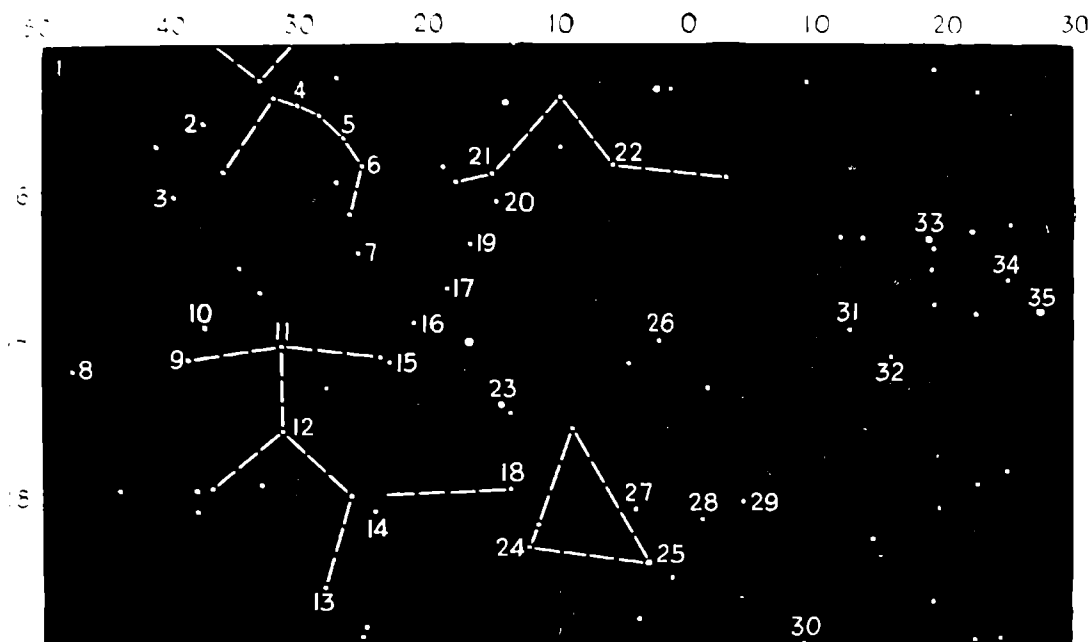


CHART VIII

Beta. Star 1, double, magnitudes 5.3, 6.2; period 204.74 years; Star 2, double double, magnitudes 4.4, 6.5, and 7.2, 7.8; period of last two, 244.37 years.

Northern Crown, Corona Borealis. Star 3, variable, magnitudes 7.2-12; variation period 358 days; Star 4, double, magnitudes 5.6, 6; period 41.5 years; Star 5, Gemma, magnitude 2.3; period 17.36 days; distance 62 light-years; Star 6, double, magnitudes 4, 7; period 87.8 years; Star 7, variable, magnitudes 7.5-14.2; period 486 days.

Hercules. Star 8, nebula; Star 9, magnitude 3.6; Star 10, variable, magnitudes 7.8-13.5; variation period 280.2 days; Star 11, double, magnitudes 3, 6.5; period 34.46 years; Star 12, magnitude 3.9; period 4 days; Star 13, double, magnitudes 3.5, 9.5; period 43.23 years; Star 14, variable, magnitudes 6-11.5; variation period 221 days; Star 15, blue-green nebula; Star 16, magnitude 2.81; period 410 days; Star 17, double, magnitudes 3.8, 8.2; Star 18, double, magnitudes 3.1, 6.1; diameter 185,800,000 miles; 21.7 light-years distant; Star 19, variable, magnitudes 8.6-14.8; variation period 317.7 days.

Serpens. Star 20, variable, magnitudes 5.6-13; variation period 357.3 days; Star 21, double, magnitudes 8.7, 9.1; Star 22, *Serpentis*, magnitude 2.8.

Ophiuchus. Star 23, variable, magnitudes 7.3-12.6; variation period 308.3 days; Star 24, magnitude 2.1; distance 60 light-years; Star 25, magnitude 2.9; Star 26, double, magnitudes 4, 6.1; period 114 years; Star 27, magnitude 4.4; Star 28, double, magnitudes 4.9, 6.2; period 46 years; Star 29, magnitude 4.6; period 26.27 days; Star 30, double, magnitudes 5.3, 6; period 223.82 years; Star 31, variable, magnitudes 7-10.5; variation period 302.5 days; Star 32, variable, magnitudes 3.8-13; variation period 233.6 days; Star 33, magnitude 2.9; period 6.8 days; Star 34, double, magnitudes 3, 8; period 0.247 days; Star 35, *Antares*, magnitude 1.2; 360 light-years distant from the earth; diameter about 450 times that of the sun. If the sun and its system were to occupy the same space, the earth would be buried throughout its orbit, as would also Mars. 121 million million worlds could crowd into *Antares*. It is a mammoth globe of incandescent gas whose density is 0.00001 that of water. It is said that it would take 17 million earths to make one sun, 27 million suns to make one *Betelgeuse*, and 91 million suns to make one *Antares*.

Scorpius. Stars 33, 34, 35 are in the constellation *Scorpius*, the *Scorpion*.

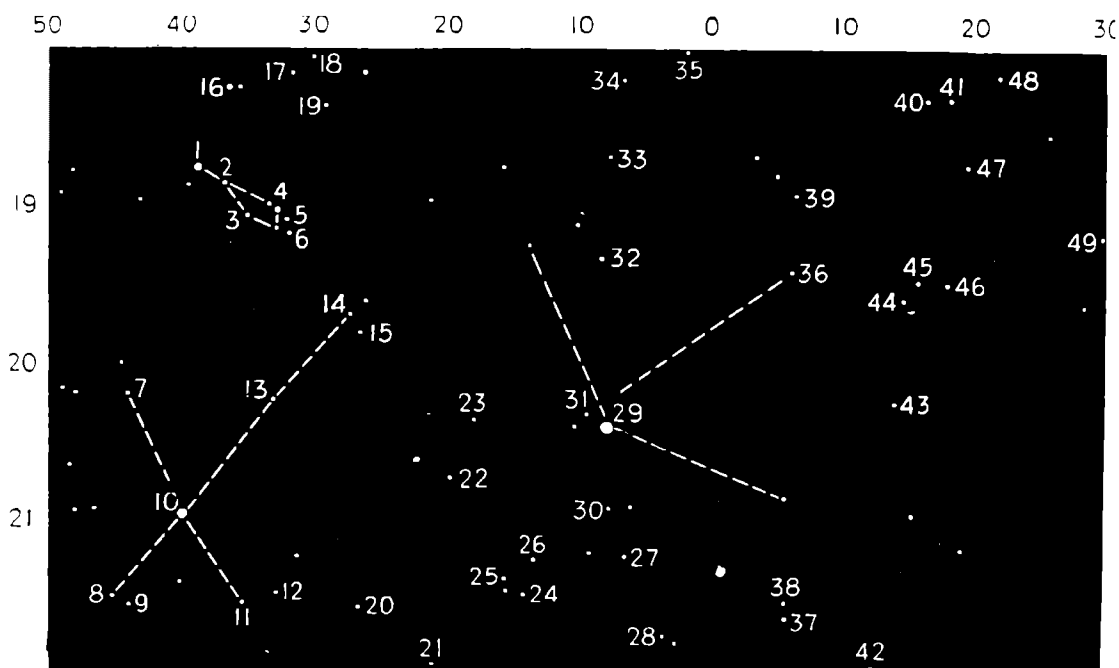


CHART IX

Lyra, the Lyre. Star 1, Vega, magnitude 0.1, brightest first-magnitude star in northern heavens, about 50 times as bright as our sun; distinctly blue-white. 1500 Vegas would give more starlight than all the stars in our heavens; 26 light-years distant, or about 8 million times as far from the earth as the earth is from the sun. Our solar system is moving towards Vega at the rate of 400 million miles a year. In about 12,000 A.D., Vega will be our polestar just as Polaris now is. Star 2, magnitude 4.3; period 4.3 days; Star 3, double, magnitudes 4.5, 6.5; period 245 days; Star 4, double, magnitudes 3.6, 7; period 12.9 days; Star 5, a ring nebula; Star 6, double, magnitudes 5.2, 8.7; period 45.8 years; Star 7, double, magnitudes 3, 7.9.

Cygnus, the Swan. Star 8, Deneb, double, magnitudes 1.3, 12; distance 650 light-years. Though at a great distance, it is very brilliant; even though it seems less brilliant than Sirius it is 10,000 times brighter than our sun. Star 9, magnitude 4.7; period 2.8 days; Star 10, magnitude 2.3; distance 540 light-years; Star 11, double, magnitudes 5, 6.3; Star 12, the eastern arm of the Northern Cross, magnitude 2.6; Star 13, variable, magnitudes 4-13.5; probably larger than Mira; variation period 406 days; Star 14, double, magnitudes 8.2, 8.2; period 243.9 years; Star 15, Albireo, double, magnitudes 3, 5.3.

Hercules. Stars 16 to 19 not conspicuous.

Vulpecula, the Fox. Stars 20 and 21 not conspicuous; Star 22, the Giant Dumbbell Nebula.

Sagitta, the Archer. Star 23, double, magnitudes 5.4, 6.4; period 25.2 years.

Delphinus, the Dolphin. Star 24, double, magnitudes 4, 5; Star 25, variable, magnitudes 8.4 to 12; variation period 277.5 days. Star 26, double, magnitudes 4, 5; period 26.8 years; Star 27, nebula; Star 28, double, magnitudes 5.8, 6.3; period 97.4 years.

Aquila, the Eagle. Star 29, Altair, blue-white, magnitude 0.9, or nine times as bright as our sun; 15.4 light-years distant; Star 30, variable, magnitudes 7.6-13; variation period 280.4 days. Star 31, magnitude 2.8; distance 112 light-years; Star 32, variable, magnitudes 5.8-12; variation period 355 days; Star 33, variable, magnitudes 6.5-9; variation period 335 days; Star 34, nebula; Star 35, double, magnitudes 4.1, 6; period 87.8 years; Star 36, not visible to naked eye.

Aquarius. Stars 37 and 38. *Scutum.* Stars 39, 40 and 41. *Capricornus.* Star 42. *Sagittarius.* Stars 43 to 49.

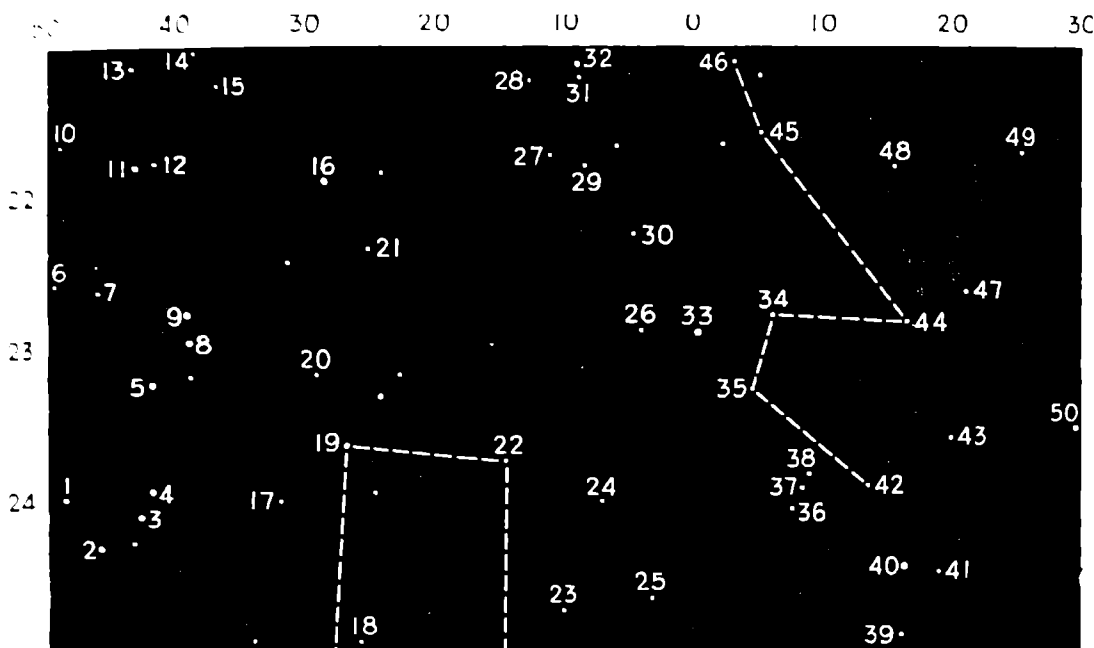


CHART X

The area here covered is relatively poorly supplied with important stars.

In the constellation *Andromeda*, we have Star 1, a rose-colored star, magnitude 5; Star 2, magnitude 4; period 20.54 days; Star 3, a bright blue-green, elliptic nebula; Star 4, magnitude 5.9; period 3.22 days.

The constellation *Lacerta, the Lizard*, shows Star 5, variable, magnitudes 8.3-14.5; variation period 198.7 days; Star 6, a cluster; magnitude 4.6; period 2.6 days; Star 8, a double double with magnitudes of 6.5, 6.5 and 8.5, 10; Star 9, variable, magnitudes 8-12.5.

The constellation *Cygnus* shows Star 10, a cluster; Star 11, a variable, magnitudes 8.4-12; variation period 105.6 days; Star 12, a triple, magnitudes 7, 7.9, 11; Star 13, a nebula; Star 14, double, magnitudes 5.5, 5.9; brightness $\frac{1}{100}$ as bright as the sun; Star 15, double, magnitudes 3.8, 8; period 47 years; Star 16, double, red-gold to purple; magnitudes 4, 5.

Pegasus is represented by Star 17, a double, magnitudes 5.5, 7.5; Star 18, double, magnitudes 5.8, 11; period 26.4 years; Star 19, Scheat, whose diameter, 150 million miles, would enclose 5 million suns; distance 541 light-years; magnitude 2.2; Star 20, magnitude 3.1; period 818 days; Star 21, magnitude 3.6, period 10.21 days; Star 22, Markab, magnitude 2.6; distance 272 light-years; Star 23, double, magnitudes 6.9, 7.5; Star 24, variable, magnitudes 7.8-13; variation period 317.5 days; Star 25, a glowing ember, magnitude 6.2; Star 26, a double, magnitudes 5.8, 7.2; Star 27, a globular cluster; Star 28, a variable, magnitudes 8-12; variation period 262 days; Star 29, a triple, contrasting colors; magnitudes 2.5, 8.8, 11.5; Star 30, variable, magnitudes 8.2-14; variation period 303 days; Star 31, double, magnitudes 5.3, 5.4; period 5.7 years; Star 32, a triple, magnitudes 4.1, 5.7, 11; Star 33, double, magnitudes 4, 4.1; Star 34, double, magnitudes 5.6, 5.7; Star 35, triple, magnitudes 7, 7.5, 8; Star 36, double, magnitudes 7, 8; Star 37, double, magnitudes 7, 8; Star 38, double, magnitudes 4, 8.5; Stars 39 to 47 either invisible to the naked eye or nearly so, and relatively unimportant.

Capricornus, Star 48, magnitude 3; Star 49, magnitude 5.

Foramhaat, Star 50, magnitude 1.3 and distance 25.51 light-years, is seen in autumn in the constellation *Piscis Australis*, or *Southern Fish*.

Miles	Temp. °F.	Name	Significance
200		F ₂ layer	Reflects short radio waves at night
150	212-2000	F ₁ layer	Reflects short radio waves by day
125			V-2 rocket
114		Ionosphere	Aurora Borealis; luminous clouds
100			Reflects broadcast waves; meteors
75		E layer	Noctilucent clouds
50	To 0	D layer	
25	170	Stratosphere	
22		Ozone layer	
20			Sounding balloon
13.7			Sound reflected
10.6			Occupied balloon
10		Tropopause	Airplane limit
5-10	To -67	Troposphere	
0-10			Mt. Everest
5.5			

Interplanetary
Space

About 2000 Miles
above Sea Level

Atmosphere
limit

AIR

ATMOSPHERE

SEA-LEVEL

LITHOSPHERE

3150 Mi.

CENTROSPHERE

2150 Mi.

Nickel
Iron

Earth
Center

MT. EVEREST
Hydrosphere Pressure
over 1000 T. sq. ft.

DEEPEST SEA

Lithosphere

1100 °F.

Lower Sial

Upper Sima

2200 °F.

30 Miles below
Sea-Level

5 Mile Range

500 Mile Range

The Earth

5000 Miles





Areas on the Moon

- 1. Sea of Tranquility, 75,000 sq. mi., 280 by 360 mi.
- 2. Sea of Rectitude
- 3. Sea of Serenity
- 4. Sea of Fertility
- 5. Sea of Serenity
- 6. Sea of Tranquility
- 7. Sea of Serenity
- 8. Sea of Fertility
- 9. Sea of Tranquility
- 10. Sea of Serenity
- 11. Alps Mountains
- 12. Plain of Plato
- 13. Bay of Rainbows
- 14. Crater of Tycho
- 15. Crater of Langrenus
- 16. Crater of Copernicus
- 17. Crater of Kepler
- 18. Crater of Aristarchus
- 19. Crater of Grimaldi

- 11. Alps Mountains
- 12. Plain of Plato, 60 mi. across
- 13. Bay of Rainbows
- 14. Crater of Tycho, 54 mi. across, 17,000 ft. deep
- 15. Crater of Langrenus, 90 mi. across, 10,000 ft. high
- 16. Crater of Copernicus, 56 mi. across, 11,000 ft. high
- 17. Crater of Kepler, 22 mi. across, 10,000 ft. high
- 18. Crater of Aristarchus
- 19. Crater of Grimaldi, 148 by 129 mi.

Phases of the Moon

- A. Waxing crescent, in West at sunset, 3 $\frac{1}{4}$ days
- B. Waxing crescent, high in West at sunset, 5 $\frac{1}{2}$ days
- C. Waxing gibbous, in South at sunset, 6 $\frac{1}{4}$ days
- D. Waxing gibbous, towards East at sunset, 7 $\frac{1}{4}$ days
- E. Waxing gibbous, further East at sunset, 9 $\frac{1}{4}$ days
- F. Waxing gibbous, still further East at sunset, 11 $\frac{1}{4}$ days

- G. Full moon, in East at sunset, 14 $\frac{1}{2}$ days
- H. Gibbous moon, in East after sunset, 18 days
- I. Gibbous moon, in East later yet, 20 days
- J. Last quarter, in East later yet, 20 $\frac{1}{2}$ days
- K. Waning crescent, late at night, 24 days
- L. Waning crescent, at dawn, 27 days

	Sun	Mercury	Venus
Location	On the average, 92 million miles from the earth, the distance varying because earth moves in an ellipse	From 43 million to 28 million miles from sun. $49\frac{1}{2}$ million miles from earth when between earth and sun and 136 million miles when sun is between earth and Mercury	Average 67 million miles from sun, 26 million miles from earth when between earth and sun, and 160 million when sun is between earth and Venus
Size	Surface area, over 12,000 times that of earth; volume, over 1,300,000 times as much; weight, 333,000 times as much, about 2 octillion tons. About $1\frac{1}{2}$ times as dense as water and $\frac{1}{4}$ as dense as the earth. Diameter, 866,500 miles, or over 100 times that of earth	Area, $\frac{1}{4}$ that of earth, or about equal to Asia and Africa combined. Volume, $\frac{1}{8}$; density, $\frac{5}{8}$; mass, $\frac{1}{20}$ that of earth. Diameter, less than $\frac{1}{2}$ that of earth, or 3,009 miles	Area, about $\frac{9}{10}$ that of earth; mass, about $\frac{1}{8}$; density, 0.87 that of earth. Diameter, 7,700 miles, or about equal that of earth
Light and other relations	While light comes to the earth from the sun in 8 minutes 19 seconds, sound would take 14 years to travel the distance if there were atmosphere to carry it. Loses 4,200,000 metric tons per second according to carbon cycle theory	Light from sun reaches planet in 4 minutes; because of dark rocks only $\frac{1}{16}$ is reflected. Because of low altitude, brilliance is faint, at its best about equaling Vega	Sunlight reaches planet in 5 minutes 50 seconds; because of bright cloud surfaces, $\frac{3}{8}$ is reflected. Most brilliant of the planets; at best, 15 times brilliance of Sirius
Movement	Completes a turn on its axis in about 25 days. With the earth at the sun's center, the moon would be about halfway between the center and outside of the sun	Moves 23 to 35 miles per second in orbit for a year of 87 days 23 hours 15 minutes, with axis 0° to perpendicular to orbit plane and 7° to right angle to ecliptic	Moves 22 miles per second in orbit 1.9 times that of Mercury for year of 224.7 days, with axis 0° perpendicular to orbit plane and $3^{\circ}5'$ to right angle to ecliptic
Sidereal day		87 days 23 (?) hours	Probably 224.7 days
Climate	Temperature at the surface, about $12,000^{\circ}\text{F}$. and much hotter inside. Heat from the sun evenly distributed over the earth would melt each year an ice covering 114 ft. thick. Only $\frac{1}{2,200,000,000}$ part of the heat radiated reaches the earth	One side bright, with temperature of 600°F .; other, dark, with temperature of -449.4°F . Little or no atmosphere	One side hot and one side cold, as in Mercury. Receives twice as much heat and light as the earth does. Densely cloudy, with clouds many miles deep
Weight variation	100 lb. on earth would weigh 2,760 lb. on sun	100 lb. on earth would equal 31 lb. on Mercury	100 lb. on earth would equal 85 lb. on Venus
Moons	Has no moons	Has no moons	Has no moons

Earth	Earth's moon	Mars	Jupiter
Varies from 91½ million miles from the sun in January to 94½ million miles in July	About 238,840 miles from the earth, or about 30 times diameter of earth at equator	Average 141½ million miles from sun. From 35 to 248 million miles from the earth, varying because of positions on their orbits	Averages about 483 million miles from sun. Between 390 and 576 million miles from the earth
Earth's surface would appear smooth to its nearest neighbor, though it appears rough to us. Volume, 259 billion cubic miles; weight, 6 sextillion tons; density: 5.53 times that of water. Diameter, 7,918 miles. Area, 196,950,000 sq. mi.	Area of surface, ¼ that of earth. Volume, ¼; mass, 0.0122; density, just over half that of earth, about 3.5 times that of water. Diameter, 2,163 miles, or about ¼ that of earth. The pull of the moon on the earth is the major cause of our tides	Area, ¼ that of the earth. Shows conspicuous polar caps, and dark markings and lines called "canals." Volume, ¼; mass, ¼-½; density, 0.73 that of earth, 3.92 times the density of water. Diameter, 4,200 miles	Surface 131.3 times; volume, 1,312 times; mass, 317 times; density, 0.24 times that of earth. Diameter through polar region, 82,880 miles and through equatorial region, 88,640 miles
Sunlight reaches earth in 8 minutes 19 seconds, nearly ½ being reflected because of clouds and dust in atmosphere. Earth intercepts one two-billionth of sun's radiant energy or power equal to that produced by burning 21 billion tons of bituminous coal every hour	When earth is directly between sun and moon, moon is eclipsed; moon eclipses sun when it is between sun and earth. A new moon appears when moon is roughly between earth and sun. About ¼ the light received is reflected	Sunlight reaches Mars in 12 minutes 30 seconds, because of cloudless atmosphere only ¼ of light received is reflected. The third most brilliant planet. Appears ruddy	Sunlight reaches planet in 43 minutes 20 seconds; because of cloud masses, ½ of that received is reflected. Second most brilliant planet, appearing a little more brilliant than brightest star
Moves 18½ miles per second in orbit 2.6 that of Mercury for a year of 365.24 days, with axis 23½° from right angle to orbit plane	Moves about the earth in 29 days, 12 hours 44 minutes 2.86 seconds, turning on axis so that the same side faces the earth at all times. Earth reflects light to moon	Moves 15 miles per second in orbit 3.9 that of Mercury for year of 687 days, with axis at 23°59' to right angle to orbit plane	Moves 8 miles per second in orbit 13.4 times that of Mercury, for a year of 11.86 earth years with axis at 3°6' to perpendicular to orbit plane
23 hours 56 minutes		24 hours 37 minutes	9 hours 53 minutes
At least 100 miles of atmosphere, all but 4 per cent within 15 miles of solid surface; atmosphere acts as a blanket against cold and diffuses light. Energy equal to 1½ horsepower per sq. yd. reaches the earth from the sun	Each side very hot for 14½ days, and as cold as -200°F. the next 14½ days. Sharp contrasts where light is cut off by shadow. Little atmosphere, probably not 1/10,000 that of the earth. So-called "seas" are darker regions, not water. Would undoubtedly be uninhabitable for man	Average 48°F. Water would boil at 111°F. Relatively small amount of water present, as compared to earth. Thin and cloudless atmosphere generally, except for clouds over poles during their respective winters	Receives about ¼ as much heat and light per unit of area as does the earth. Average temperature -200°F. Covered with cloud mass at least 1,000 miles deep, composed of ammonia and methane and probably also nitrogen and hydrogen. Occasional red probably nitrous oxide
	100 lb. on earth would weigh 16½ lb. on the moon	100 lb. on earth would weigh 38 lb. on Mars	100 lb. on earth would weigh 264 lb. on Jupiter
Has one moon. See next column	Has no moons	Two moons. Phobos, about 10 miles in diameter and 5,850 miles from planet center, has period of 7 hours 39 minutes, rises in west and sets in east. Deimos, about 5 miles in diameter and 14,650 miles from center of Mars, rises in east and, 65½ hours later, sets in west	Nine moons, all rising in east and setting in west. Io, about size of earth's moon, and Europa, slightly smaller; Ganymede, a little larger than, and Callisto about the size of, Mercury

	Saturn	Uranus	Neptune	Pluto
Location	Nearly 10 times the distance of the earth from the sun, or 887 million miles. From 734 to 1,017 million miles from the earth, depending on place in orbit	1,781,900,000 miles from the sun. Average 1,800,000,000 miles from the earth	2,791,600,000 miles from the sun; about 2,800,000,000 miles from the earth	Averages 4 billion miles from the sun; at its minimum distance, nearer the sun than Neptune is. Most eccentric orbit of any planet
Size	Surface area 81.4 times; volume, 734 times; mass, 95 times, that of earth. Mostly liquid, $\frac{1}{2}$ the density of earth; would float on water. Solid part relatively small. Diameter, 66,300 polar and 74,100 equatorial miles	Surface area, 16 times; volume, 60 times; mass, 14.66 times; density, 0.25 times that of the earth. Density, 1.27 that of water, about $\frac{1}{4}$ that of earth. Diameter, 30,900 miles	Surface area, 18 times; volume, 72 times; mass, 17.16 times; density, 0.3 that of the earth, 1.6 that of water. Diameter, 32,900 miles	Surface area, volume, density, and mass not known. Diameter, probably about that of Mars
Light and other relations	Sunlight reaches the planet in 1 hour 19 minutes 30 seconds; $\frac{1}{2}$ of that received is reflected. Brilliance of first-magnitude star, with dull, steady, orange light	Sunlight reaches planet in 2 hours 31 minutes 35 seconds, about $\frac{3}{20}$ of that received being reflected. Appears sea green in color and at best is just visible to naked eye	Sunlight reaches the planet in 4 hours 10 minutes 35 seconds, and about $\frac{1}{2}$ is reflected. Seen only with telescope and appears much like Uranus	Sunlight reaches planet in about 5 hours 30 minutes; amount reflected is not known. Barely visible on clear night with 15-inch telescope
Movement	Moves at 6 miles a second on orbit 24.6 times that of Mercury, with axis tipped at $26^{\circ}48'$ to perpendicular to orbit plane for a year of 29.46 earth years	Moves 4 miles per second in orbit 49.5 times that of Mercury for a year of 84 earth years 7 days, with axis probably 98° from right angle to orbit plane	Moves at 3.4 miles per second in orbit 77.5 times that of Mercury, with axis inclined by unknown amount from perpendicular to orbit plane for a year of 164.8 earth years	Moves at 1.8 miles per second in orbit $\frac{2}{3}$ that of Neptune; orbit more inclined to plane of earth's orbit than that of other planets; year equals 248 earth years
Sidereal day	10 hours 15 minutes	10 hours 42 minutes	15 hours	Not known
Climate	Receives about $\frac{1}{60}$ as much heat and light per unit of area as does the earth; temperature about -300°F . Covered by deep cloudy atmosphere with ammonia snow much like that of Jupiter, and with brilliant white clouds of unknown composition appearing about once in 10 years	Close to absolute zero, or -449.4°F . Receives about $\frac{1}{80}$ as much heat and light per unit of area as does the earth. Vast cloud-laden atmosphere containing gaseous methane and probably nitrogen and hydrogen. Clouds are ammonia snow, possibly with liquid droplets of ammonia and methane in suspension	Receives about $\frac{1}{600}$ as much heat and light per unit of area as does the earth. Atmosphere in general similar to that of Uranus	Nature of climate not known. Probably has no atmosphere
Weight variation	100 lb. on earth would weigh about 117 lb. on Saturn	100 lb. on earth would weigh 90 lb. on Uranus	100 lb. on earth would weigh 89 lb. on Neptune	Weight of 100 lb. on Pluto not known
Moons	Nine moons. Titan about equal to earth's moon; Rhea and Iapetus, each about 1,100 miles in diameter; five, from 800 to 300 miles through; one, smaller. All rise in east and set in west. Three flat concentric rings less than 50 miles thick circle planet, appearing on edge about once in 15 years. Inner edges about 8,000 miles and outer edges, which move more slowly, 86,000 miles from planet center. Composed of small particles each in orbital motion about Saturn	Four moons. Ariel, 120,000 miles from planet, encircles it in 2.5 days; Umbriel, 167,000 miles, in 4.1 days; Titania, 273,000 miles, in 8.7 days; and Oberon, 365,000 miles, in 13.5 days	One moon, about the size of earth's, rises in east and sets in west, going around the planet once every 6 days	No moons known

The Mineral Kingdom

Since both the Plant Kingdom and the Animal Kingdom are dependent on the Mineral Kingdom for continued existence, it is important that the Mineral Kingdom be reasonably understood by the one member of the Animal Kingdom able to modify his environment to his advantage or disadvantage (see p. 608).

At least two things of importance stand out in this planning. Some parts of the Mineral Kingdom are essential to our way of life and are present on the earth in limited quantities. It is reasonable to assume that we cannot renew our mineral resources by drawing on other parts of the universe, and many of our dwindling mineral resources are definitely not renewable. Each generation of human beings will find itself facing a new set of problems brought into prominence by dwindling resources, new demands created by scientific discovery and the discovery of new uses of resources now considered useless. World economics, politics, and happiness are dependent largely on the use or abuse made of the resources at hand in different parts of the world. It therefore behooves us all to be able to recognize at least a few of the important mineral resources at hand and to understand their interrelationships with each other and with plants and animals.

Much as soap and pie and bread are generic names for happy or unhappy combinations of the materials of which they are made, so are the rocks we recognize combinations of minerals in different proportions and subjected to highly variable treatment. No two pies or soaps are alike and similarly no two granites or sandstones are alike. Two granites may have identical chemical composition but one may have been subjected to a vastly different combination of heat and pressure. Those differences will appear in the rocks.

In the identification of minerals in the following tables at least two sets of standards will have to be recognized: differences in hardness and differences in fusibility. These are explained here. Other differences are explained in any good dictionary. In a few cases space has necessitated the use of unusual terms but usually identification may be made without recognition of such minor differences as crystal forms or luster.

In the table of hardness given below, a material will scratch any material with a lower number, *i.e.*, Topaz will scratch quartz but not corundum.

TABLE OF HARDNESS

- 1 Talc, scratched by thumbnail
- 2 Gypsum, scratched by thumbnail
- 3 Calcite, scratched by soft pin but not by thumbnail
- 4 Fluorite, scratched by soft iron but not by pin
- 5 Apatite, scratched by point of good knife but not by soft iron
- 6 Feldspar, scratched by glass and by very hard knife but not by poor knife
- 7 Quartz, not scratched even by common glass
- 8 Topaz
- 9 Corundum
- 10 Diamond

Six minerals are chosen as standard in measuring fusibility in a blowpipe flame.

TABLE OF FUSIBILITY

- 1 Stibnite, very easily fusible
- 2 Chalcopyrite, easily fusible
- 3 Almandine garnet, of medium fusibility
- 4 Actinolite, intense heating necessary
- 5 Orthoclase, prolonged heating necessary
- 6 Bronzite, very hard to obtain any evidence of fusibility

Streak characteristics may be demonstrated by observing the color made by rubbing the mineral to be tested on a piece of unglazed porcelain.

ATMOSPHERE AND HYDROSPHERE AND LOOSE MANTLE MATERIALS

Atmospheric Water

Water vapor and moisture in atmosphere mean the same thing. The amount present varies from practically nothing to 4%. As vapor condenses it becomes visible as fogs and clouds that may evaporate and vanish. Increased barometric pressure and a lowering of temperature may speed condensation. Moist air is lighter than dry air, being normally about 62% as heavy under similar conditions.

Because it is lighter, moist air is displaced by heavier dry air and rises. These changes contribute considerably to the making of weather and of humid and arid areas on the earth and consequently to the nature and abundance of life in different places.

Snow, Sleet, Glaze, Hail

When water vapor condenses in air at a temperature below 32°F., snow is formed. When the condensed rain freezes in the air after it has formed into drops, sleet is formed; when rain comes in contact with sufficiently colder objects, it becomes glaze. Hail is formed by frozen rain being forced upward by strong rising columns of air into regions where ice is added to the existent pellets.

Snow crystals are 6-sided, of an infinite variety of types, the types usually indicative of the conditions under which the crystals are formed: they usually fall to the ground through the air by the force of gravity much as sediments of sand and silt are settled out of water or dust out of air.

Surface Water

Nearly $\frac{3}{4}$ of the surface of the earth is covered with water. From this surface water evaporates, leaving mineral deposits in an ever-increasing concentration. Moving to the lower levels of the surface of the earth, the water carves this surface volently by gully erosion or inconspicuously by sheet erosion. When it moves, it carries with it the more buoyant materials at hand.

Erosion control practices beginning on a 3% slope are designed to hold desirable plant foods in position. Sudden and violent descent of surface water provides power that may support industry and may relieve man and other animals of labor. A sustained yield of power is attained by dams that hold back surpluses and incidentally also serve to prevent floods and to help sustain navigation and water supply.

Snow Banks

When snowflakes come to rest on the ground, they may form something comparable to sedimentary rocks like sandstone and shale. Successive deposits of snow may show as strata in snow banks, just as strata show in ordinary sedimentary rocks. Changing temperatures and varied deposits produce readable changes in the banks. Dust and dirt also may appear in definite layers.

Snow banks serve splendidly as a thermal blanket over the earth modifying otherwise sudden temperature changes that might be fatal to plants like winter wheat. They also provide a cover that protects mice from hawks and other predators. They interfere with or assist transportation and, to some degree, delay the runoff of waters that may have fallen on the earth as snow.

Ground Water

Water that falls on the surface of the earth evaporates, runs off, or penetrates the porous portions. Eventually it reaches an impervious region and accumulates variously. As ground water, it may constitute a reserve available for the use of plants and animals able to reach it when the upper earth surfaces become dry. At different depths, the chemical nature and the temperature of ground water may vary considerably.

The varied ability of plants to reach the water table may well determine the plants to be found in a given area. Deep-rooted plants may appear to thrive under conditions fatal to adjacent shallow-rooted plants. Burrowing animals may reach water not available to nonburrowers.

Ice

When snow has continued to accumulate, the weight of the upper layers may well change or metamorphose the snow in the lower layers. Pressure may well change snow to ice as it does in glaciers on sloping mountaintops or on sloping rooftops. The ice gradually makes its way downward, carrying with it earthy materials from the mountain or roof.

Since ice is 92% as heavy as water, it floats in water. In many rapidly flowing streams, ice may carve the stream beds considerably. It may also pluck and carve rocks of gorge walls or grind the shores of lakes and oceans. It may blanket ponds, shutting off light and upsetting biological balances that may have been established, and it may hold life captive under water or in snowbanks.

Water

Water is fluid between 32 and 212°F., solidifying at the lower figure and vaporizing at the upper. In centigrade, these points are 0° for freezing and 100° for boiling. Water expands when it freezes and ice has a specific gravity of 0.92 instead of the standard 1 of water. Water is colorless, tasteless, transparent and in its natural impure state readily dissolves such substances as lime and salt (see pp. 33 and 38).

Because water is the great solvent of nature, it occurs with many kinds of solutes. Distilled water is of course free from impurities; rain may bear sulfur, dusts of many sorts, and oxygen and carbon dioxide absorbed from air in descending; flowing waters may dissolve lime carbonate, sulfur, lithia, and salt from rocks; sea water may become very saline. Soft water is more largely acid while hard is calcareous.

The water cycle is important in the distribution of important compounds in nature. Falling rain may remove some elements of impurities from the air. These may be added to through contact with the soil and rocks or may be concentrated through evaporation of water and the precipitation of compounds that have been in solution and through movements of water in soil.

Water of course is the basic material in which living protoplasm, whether in plants or in animals, functions. It is obvious that it also is useful as a source of power, as a means of transportation, in fighting fire, in the removal and elimination of wastes, in encouraging or in discouraging different chemical actions, and as an unexcelled drink.

Natural Gases

Gases are an essential part of nature so far as life is concerned. In them are suspended water particles in the form of clouds. They may themselves be dissolved in water and in other liquids. They readily enter porous soils and rocks. Their expansion and contraction due to temperature variations change solids mechanically and the elements in them also may change solids chemically.

The more important gases in nature, aside from atmosphere, which is of course a mixture of gases, are the natural gases that are used as fuels, sulfur gas that issues from volcanoes and elsewhere and affects adjacent life, carbon dioxide gases that arise from oxidation processes or from the earth.

The nature and relative abundance of different gases at different places at different times are usually parts of cyclic changes that take place. There is a sulfur cycle, a carbon cycle, a nitrogen cycle, and so on; all these working simultaneously with other natural processes contribute to making an environment suitable to plants and animals.

Many natural gases have found specific uses in man's complicated life. For example, by pressure carbon dioxide is solidified to form dry ice. Natural gas provides a basic fuel more easily distributed than solid fuels in many cases, cleaner and sometimes cheaper. Other gases are important in refrigeration, so necessary for food preservation. Without atmospheric impurities such as dusts and water particles, there would be no glorious sunsets.

Dusts, Silts, and Clays

Silts range in diameter from 0.002 to 0.05 mm. while clay particles are below 0.002 mm. in diameter. Loess is fine-grained, wind-blown dust that has settled. Gumbo is a fine, silty soil that when wet becomes sticky, almost mucilaginous and impervious and soapy. Loams are mixtures of sands, clays, and organic matter. Silt plus clay plus water makes mud.

Silts, clays, and muds may be moved by air, water, gravity, or ice as are the larger sands and gravels and are similarly classified on this basis. They tend to compact and prevent the entrance of air and water or, when dry, to contract and crack in large units unless flocculated by substances like lime that bring small units together around independent centers.

Silts, clays, and muds may consolidate to form shales of homogeneous or heterogeneous nature, of varying degrees of hardness, of highly variable chemical nature depending on the basic materials involved; these may metamorphose to form slates or similar metamorphic rocks. Evaporation, capillarity, gravity, and exhaustion by plant use may change the nature of silts and clays.

Properly managed, these fine inorganic particles may make the agriculture of an area. Improperly managed, they may break it by being carried away by water or wind, or by sealing over soils more suitable for plant growth. Many clays are basic in ceramics, in brickmaking, in the arts. Some are useful in polishing and some as sources of important component minerals.

UNCONSOLIDATED MATERIALS

Gravels

Mechanical analysis: Diameter of fine gravel, 1-2 mm.; granule gravel, 2-4 mm.; pebble gravel, 4-64 mm.; cobble gravel, 64-256 mm.; boulder gravel, 256 to over 1,000 mm. Units may be either rounded and waterworn or angular and unworn. Technical soil standards allow 7-8% of loam in fine gravel classification.

Some geologists classify gravel units under "size of pea" as sand. Sands and gravels at point of origin are *residual*. Those carried by gravity are *colluvial*; those carried by streams, *alluvial*; those formed in lakes, *lacustrine*; those in the sea, *marine*; those by ice, *glacial*; and those by wind, *aeolian*. Loose gravity-assembled gravels are commonly angular *talus*.

Consolidated gravels with rounded surfaces make *conglomerates* while consolidated angular talus or angular gravels make *breccias*. These may under suitable conditions be metamorphosed into *quartzite conglomerates*, *quartzite breccias*, and other rocks. Gravels because of their weight are naturally settled out of flowing streams before the finer sands, which in turn settle out before the silts.

Gravels are used commercially in road building and in the making of concrete a strong mixture is 1 part of cement to 2 parts of sand to 4 parts of gravel, which yields concrete that resists 1,500 lb. crushing weight per sq. in. but has only 400 lb. tensile strength and weighs about 150 lb. per cu. ft.). Gravel provides for drainage about buildings and has other uses.

Sands

Mechanical analysis: Diameter of coarse sand, 1-0.5 mm.; medium sand, 0.25-0.5 mm.; fine sand, 0.1-0.25 mm.; very fine sand, 0.05-0.1 mm. Allowed per cent of loam and clay: coarse sand, 16.8%; medium sand, 13%; fine sand, 3%; very fine sand, 44%. Specific heat: 0.185-0.198. Specific gravity: around 2.65. In addition to above groups, gravelly sands and loamy sands are recognized.

Soil technologists use the above as standards. Some geologists consider units up to "size of pea" as sand. *Residual sands* may be angular while *waterworn sands* are rounded; *wind-borne sands* like loess are angular, or, if in desert formations, are more perfectly rounded. Chemically, sands may be of any rock material such as quartz or limestone, the nature varying accordingly.

Sands are almost invariably produced by the breaking down of larger units and a resorting of units according to size by gravity, water, or wind. The longer or more violent the sorting and wearing process, the smaller the resultant units. They may be consolidated into sandstones of different types. In spite of their actual weight, they make light soils as compared with the lighter weight clays.

Quartz sand is used for making glass, polishing sand, molding sand, hour-glass sand (from deserts), drinking-water filters, ballast for boats and balloons, furnaces, for confining or for extinguishing fires. Since sands do not hold water well they are mixed with clays to lighten soils. They vary much in their durability. Some contribute to the acidity of soils.

Siliceous Deposits

Quartz sand of course is siliceous. Disregarding this, we find much silica deposited variously and rather continuously from many sources. Anyone recognizes the readiness with which water carries lime in solution or otherwise. Few recognize that approximately $\frac{1}{4}$ as much silica as calcium bicarbonate is carried by water in one way or another.

Sources of siliceous deposits include fine silica particles deposited from suspension or from colloids in fresh water or more commonly probably in salt water. Again, silica may be deposited from the bodies of animals or of plants. Spicules in sponge skeletons, portions of shells, shells of microscopic animals, "glass" shells of diatoms are but a few of the organic sources of silica.

Diatoms reproduce rapidly, about once every 5 days; so an uninhibited one might yield over 60 tons in a year. In the Southern Hemisphere, over 10 million sq. miles of sea bottom are covered with diatomaceous oozes. In California, there is a bed nearly $\frac{1}{2}$ mile thick of deposits of these plants. In a short time, a ridge nearly 6 in. thick and 20 miles long was deposited on our Washington coast.

Siliceous earths may contribute to formation of flints and cherts. Deposition at present is probably greatest where fresh waters flow into salt water. Fine polishing powders, waterglass, tooth pastes, fireproof packings, soaps, scouring mixtures, and many explosives include as essentials some of the siliceous materials here briefly discussed.

Limestone Deposits

Limestone deposits are commonly but not always light colored. They effervesce with hydrochloric acid. At about 900°C., they free carbon dioxide and leave calcium dioxide or slaked lime which, exposed to air, takes up water and again becomes hard calcium carbonate. Types include coral, coquina, hydraulic limestone, chalk, onyx, travertine, bog lime, marl, and so on.

Bog lime commonly is precipitated from plants; *chalk*, formed by shells of Foraminifera; *coquina*, by cemented shell fragments; *coral*, by cementing of coral particles with plant action involved; *travertine* and *onyx*, by evaporation of water from saturated lime waters; *encrinal* limestone, from crinoids, and so on. Many are readily dissolved in water and then precipitated out.

Limestone deposits may originate from fragmentation of larger limestone units, by deposition from mixtures brought together by currents, by mixtures of volcanic gases with water, by mixtures arising from actions of springs, by breaking of shells or skeletons of animals, by action of marine algae like *Lithothamnium* or freshwater algae such as *Chara* (p. 42), by bacterial action and evaporation.

Limes are used in making mortar, hydraulic limestone that hardens under water like portland cement, in making portland cement, in building stones, in road making, in industry, in the flocculation of clay soils making them lighter, in correcting acidity of sour soils, in part as plant food, and in assisting plants to take up food from soil.

Plants and Plant Products in Soils and Rocks

Vigorous plant growth penetrates soils or some rocks letting in air, water, and organic matter and changing the chemical nature of the soil. Dead plants or plant material may become a part of the soil adding to the humus that is the basis of our agricultural wealth.

In *bogs*, acid conditions prevent complete decay and plant remains accumulate at the rate of possibly 1 ft. in 10 years. As this *peat* is put under pressure of new material above, it may be compressed. Raw peat 20 ft. deep might produce 1 ft. of *bituminous coal*. Probably 300 years of plant growth is involved in development of basic material for 1 ft. of coal.

Bituminous coal may be metamorphosed into *anthracite*. It is estimated that virgin North America had an average of 9 in. of top soil and that without management 1 in. might be added in 500 years. With encouragement of plant growth, we can probably speed this up to form $\frac{1}{2}$ in. of top soil from subsoil in 1 year. *Oil shales* and petroleum products are of marine origin. Oil may collect in shales formed as fresh-water deposits but they originate in a salt-water situation.

Plant materials or other materials of organic origin in earth and rocks yield us peat, lignite, coals, oils, and petroleum that provide the heat, power, and light that make our civilization possible. Since some of these resources are not renewable as are top soils, their wise use is a social responsibility that cannot be avoided.

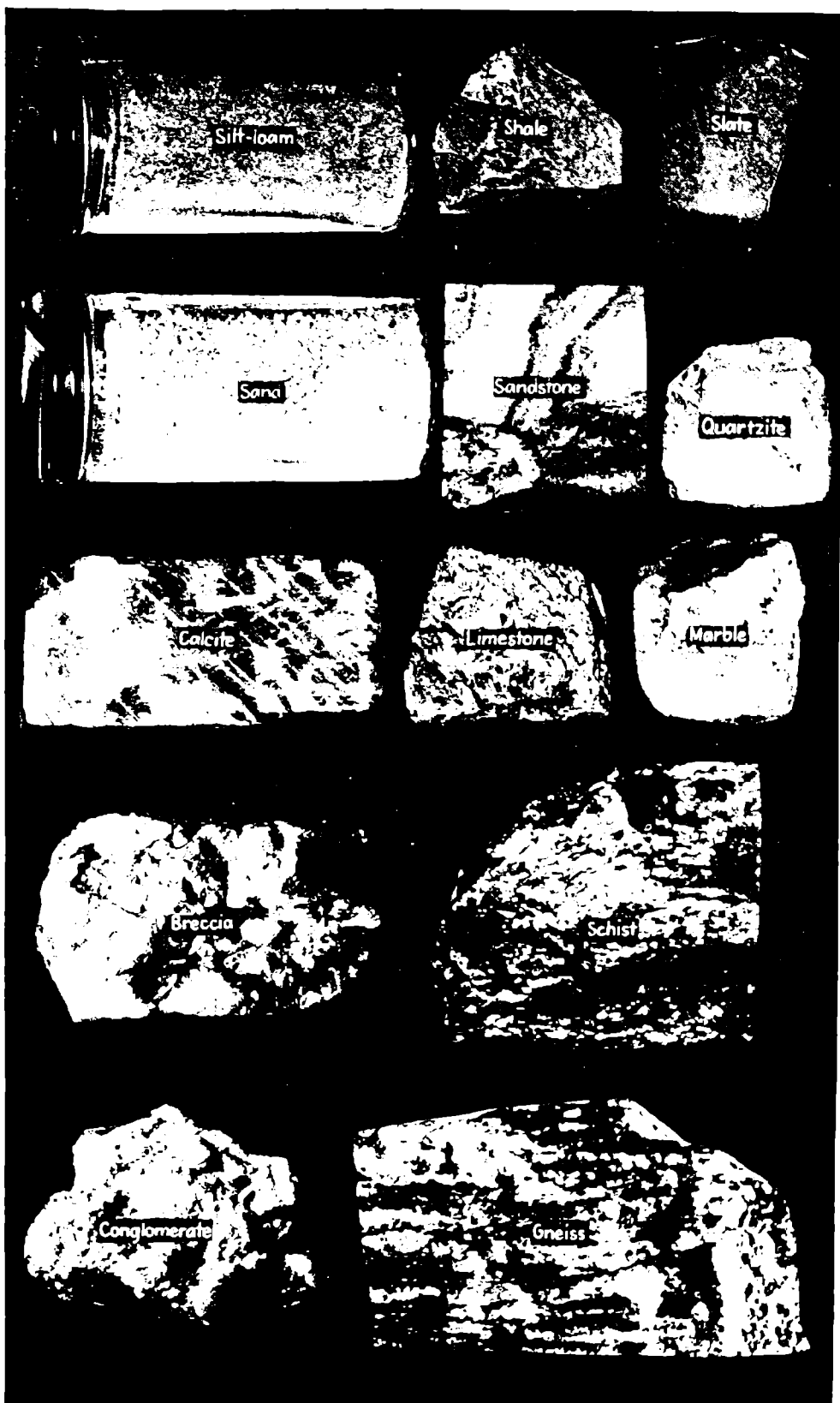
Phosphates and Animal Remains in Rocks

Animals may contribute not only shells of lime but other important materials. Some may possibly make some contribution to oils. Certainly, some contribute to the development of phosphate deposits. Basically, phosphates probably come from apatite (see p. 34) but some directly useful phosphates come from manure of animals.

Most phosphate rocks get their phosphorus from igneous rocks. In sedimentary rocks, the phosphate may constitute 85% of the rock. It may be derived also from bacterial disintegration of animal remains. A complicated series of changes probably took place in some cases involving deposits of phosphates and lime with a removal of one or the other and a redeposit elsewhere of the removed material.

Guano is the name applied to accumulation of manures of birds, bats, and similar animals where conditions are dry and it is not readily leached away. There is a definite phosphorus cycle of importance to the affairs of living things. Freed from igneous rocks, phosphorus in one form or another enters the bodies of plants and animals.

No plant or animal can live without phosphorus. Fortunately for America, we produce about $\frac{1}{2}$ the world's supply of phosphorus from phosphate rocks, while western South America has been important as a source for phosphates taken from guano. Most phosphates are used as agricultural fertilizers but they are also used in explosives and in the arts and in industry.



SEDIMENTARY ROCKS

Conglomerates

Technically conglomerates are cemented masses of waterworn pebbles, sands, and gravels. The component sands and gravels may or may not have been sorted and may or may not have a common origin. Consolidated angular talus units are distinguishable from the rounded units in a conglomerate. Consolidated angular talus makes *breccia*. The cements vary.

The nature of the component parts of conglomerate or of breccia of course determines the nature of the aggregate, whether this applies to the cement or to the cemented parts. Where the cements and the parts vary much in color, *puddingstones* are formed. Conglomerates are commonly named from their component parts, as *quartz conglomerate*.

Since the units in conglomerates are waterworn, it is safe to assume that conglomerates indicate their formation under water. The larger the units, the more probable it is that they were formed under swiftly flowing water. They are therefore useful in interpreting the geologic past of an area. They may become metamorphosed possibly into such rocks as some of the quartz conglomerates.

Some fine-grained conglomerates with varying colors are cut and polished to make attractive stone objects. They may be used as building stones where the cements are well established. The commoner cements are iron oxide, lime carbonate, and silica. These often determine considerably the nature and durability of the resultant conglomerate.

Sandstone

Where sand is cemented together but the individual grains are still identifiable, we have *sandstone*. Commonly, it is quartz sand, and usually the particles are smaller than peas. If the particles are larger, the rock is a *conglomerate*. Sandstone may be sufficiently porous to absorb a quarter of its volume of water. Some have no cements but in others the cements vary greatly.

Grit is composed of angular, coarse-grained quartz sand; *flagstone*, of thin beds with layers of easily splitting mica; *freestone*, of thick beds of uniform sands; *arkose*, of angular quartz and feldspar; and *graywacke* of quartz, feldspar, and some other mineral. Compacted silts make *siltstone*. Pore spaces varies from 5-30%; weight, from 125-150 lb. per cu. ft.; specific gravity, about 2.6.

On the basis of the cements involved, sandstones are classified as *ferruginous* if the cement is iron oxide; *calcareous*, if lime carbonate; *siliceous*, if silica; *argillaceous*, if clay; and *micaceous*, if mica. Obviously, *argillaceous* sandstones would be less durable than siliceous sandstones. Sandstones constitute about 15% of our stratified rocks.

Sandstones that are porous make excellent water filters and great reserves of water are stored underground in porous sandstones. Sandstones are used in building materials, the celebrated "brownstone fronts" of New York City being sandstone. They are also crushed and used in road building. They may metamorphose into quartzites or other metamorphic rocks. Crushing strength is from 1,500-15,000 lb. per sq. in.

Shale

Consolidated muds of various origins laid down in layers that usually split readily are *shales*. They vary from those that are uniform to those that are not, those that are hard to those that are soft, those that are well-consolidated to those that are not. They may or may not contain many extraneous materials such as sand, organic remains, and so on.

Calcareous shales have more or less lime carbonate in them; *arenaceous shales*, more or less sand; *ferruginous shales* (usually red), more or less iron; *argillaceous shales*, little besides clay; *bituminous shales*, more or less plant and animal remains; *carbonaceous shales* (usually black); *fossiliferous shales*, many fossil remains; and *oil shales*, more or less oil.

Shales are not ordinarily durable when exposed to the elements. They readily disintegrate to form muds that may contribute to the making of new shales. They may on the other hand become more consolidated and metamorphosed to form *slates* or similar metamorphic rocks. They are for the most part no doubt formed originally of water-deposited silts and muds.

Shales have little use as building stones, but crushed they may be used in road building, though here they are inferior to harder materials. They are mixed with lime in the making of portland cement. Their presence underground may contribute to the development of springs, and when porous they may affect the water table.

Limestone

Deposits of lime carbonate in the form of marl, shell remains, bog lime, and so on may be consolidated to form limestones, the nature of the limestone depending considerably on the nature of the contributing limy material. Fine particles definitely make limestone with qualities different from those formed of large particles, and impurities make their own particular changes.

Limestone, of course, effervesces with hydrochloric acid as does the basic lime material. It may be more or less readily dissolved in water, affecting the quality of the water and the nature of the movement of water underground and of the underground structure. Pure limestone is white but gray, green, brown, black, or red forms are found. It metamorphoses into *marble*.

Limestone material has almost always been deposited under water, either fresh or salt. *Chalk*, a fine-grained limestone, is caused by Foraminifera; *coquina*, by shell fragments; *hog lime* by plant action in precipitating lime; *lithographic limestone* is a fine, dense limestone with conchoidal fracture that is resonant when struck.

Limestone is the basis of most portland cement. Fired at 900°C. it frees a gas. The remaining calcium oxide, mixed with shale and some gypsum and ground, gives us cement that when mixed with water hardens into portland cement used in building houses, roads, and even ships. Limestones may be used directly as building stone. The chalk used in schools now comes mostly from gypsum.

Bituminous Rocks and Petroleum

Plants and animals of the past prevented in various ways from complete decomposition have left remains that may be consolidated into rocks of a sedimentary nature or may have freed oils and similar products. *Bituminous* or soft coal is more compacted than *lignite* or brown coal, which in turn is more compacted than *peat*. In all of these, plant remains may often be easily identified.

Bituminous coals are heated in closed ovens to drive off the gas, oil, and other materials derived from them. One ton of soft coal may yield 1,400 lb. of *coke*, 19 lb. of ammonium sulfate, 10,000 cu. ft. of illuminating gas, 2 gal. of oil, and 7 gal. of tar. Some soft coals do not "coke" and are less useful for certain purposes.

Cannel coal, a variety of coal derived probably from the spore accumulations of ancient club mosses, may eventually be used as an important source of gas and petroleum. Coal is usually associated with fresh-water deposits; petroleum, with salt water. Bituminous coals may metamorphose into *anthracite* coal. Lignite crumbles; soft coal breaks easily; hard coal fractures conchoidally.

Coal of course is the basis of much industry. Coke is essential in the making of steel and the tar by-products are the basis of the coal-tar industry that provides us with medicines, dyes, plastics, and so on. Some by-products are valuable as agricultural fertilizers. Soft coal is the world's most abundant, most widely distributed.

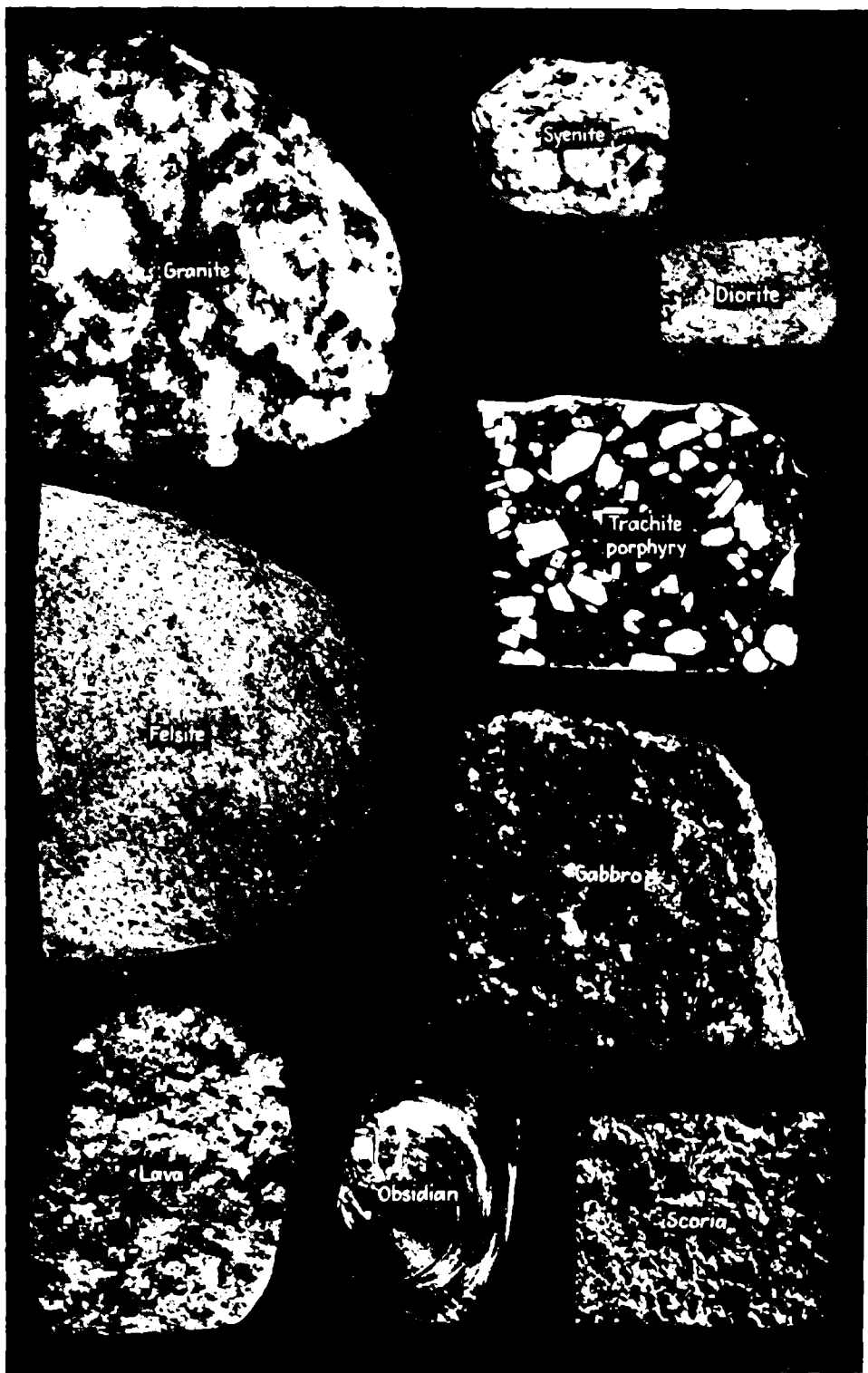
Phosphate Rock

Phosphates appear variously in sedimentary rocks either in beds mixed with other materials rather uniformly or in concentrations in other kinds of rocks. They may collect in cavities after being leached from other rocks. The deposits may be either in concentrations in large cavities or in the smaller cavities in such rocks as porous sandstones.

Sometimes phosphates that have collected in large cavities are freed in the breakdown of erosion and by water are carried to concentrations in new sites. Some of the important concentrations of phosphorus in rocks in commercial quantities are in Florida, the Carolinas, Idaho, and Kentucky. In Idaho, some beds are 15 ft. or more in thickness, the concentration being to 35%.

Phosphorus from apatite (see p. 34) is moved in water as phosphoric acid or calcium phosphate and is soluble in water rich in carbon dioxide. Bacteria help in the precipitation, as do animals that use the phosphorus from plants and from other animals. Phosphatic nodules have been found in seas at depths of 1½ miles.

The presence of phosphates in agricultural soils is essential to economic success; since they may be lost by leaching, by use, or by continuous removal of phosphorus-rich products, practices should be employed that conserve the supply available to an individual or to a community. Other sedimentary rocks include *rock salt* (p. 33), *rock gypsum* (p. 38), *chert* (p. 35) and *iron formations* (p. 37).



METAMORPHIC ROCKS

Quartzite

Metamorphosed sandstone in which the elements have been so firmly metamorphosed or cemented that they lose their identity may be *quartzite*. Such rocks are very heavy and splinter when broken or show a conchoidal fracture. They lack almost wholly the porous nature of the basic sandstone: when broken, the sand grains split, rather than separating from their adjacent grains.

Quartzites are composed mostly of quartz, but this may be accompanied by mica, feldspar, and chlorite. In such cases, the quartzite is distinguished by the compounding of these names with quartzite. In glaciated areas, they may usually be easily identified by their hardness and extra weight. In glacial gravels, they are worn smooth with very little flar fracture such as appears in softer rocks.

The sand particles in quartzite may have been cemented together with silicon dioxide. Under heat and great pressure, the material becomes almost homogeneous. Where the quartzite is pure quartz it is almost impossible to shape quartzite rocks to a desired form. Some with calcite, mica, graphite, hematite, and similar soft materials may be more easily worked.

Quartzites make superior road ballast that may last almost indefinitely. Quartzite composed of pure quartz may be ground and used in the making of glass, but one rarely if ever sees quartzite used in making so-called "durable" monuments. These are made of the softer granites and marbles. Quartzites are relatively abundant on the rockbound coasts of New England.

Schists

Rocks that look somewhat like a medium to coarse, somewhat layered collection of consolidated identifiable minerals, that split in one direction, that are composed largely of quartz and usually lack the feldspar found in gneiss and granite may be considered as *schists*. Feldspar of granites may be replaced by softer mica, talc, or chlorite or by amphibole or pyroxene.

While schists break in a plane in one direction, they break irregularly at right angles to that plane. In their coarser forms, they may intergrade into *gneiss* and in the finer forms into *slate*. Because they are softer, they can be broken up more easily with power machinery; because they are more porous, they succumb more readily to freezing and general weathering.

Schist varieties are named after their component parts such as *quartz* (hard, brittle), *garnet* (rounded, bumpy), *mica* (soft), *chlorite* (soft, greenish), *talc* (soft, greasy), *hornblende* (dark green to black) schists and they vary greatly in color. Exposed to weathering in a road cut, the color and texture change in a year may be startling under severe weathering conditions.

Schist bases for dams are dangerous because water leaching and action may undermine dam foundations and cause trouble. A few national disasters have been traced to structures on such rocks. Schists are popular with road builders since they provide a relatively easily worked hard heavy rock that appears durable. Unexposed to weathering, schists may be genuinely durable.

Gneiss (definitely banded, coarsely granular, largely feldspar)

In these rocks, the elements must be coarse enough to be identified as such with the naked eye and there must be obvious banding. Without banding, the material might well be considered as a granite. Banding may be continuous, interrupted, straight, curved, or even twisted; the color may be red, brown, gray, green, or black although some are almost white.

The usual minerals in gneiss are quartz, feldspar, and mica or hornblende, much as they are in granite. Different gneisses are named from the materials from which they are derived as *biotite gneiss*, *gabbro*, *muscovite*, *syenite*, *hornblende*, *diorite*, *garnet*, and *granite gneiss*. Names descriptive of structure are *foliated*, *banded*, and *augen* (eye-shaped masses) *gneiss*.

In gneisses, the components may be in part represented by the streaks or bands, the metamorphism not completely changing the evidence of the source of the material. They are altered by heat and tremendous pressure. Hornblende may replace the mica, and garnets may occur in gneisses. Gneisses originate deep in the earth and become exposed by wearing away of the upper coverings.

Gneisses appear abundantly in the West in the Rockies, the Cascade and the Sierra Nevada ranges, over most of Canada, in New England, along the Appalachian areas, and in the Lake Superior region. They are heavy, make excellent roads and ballast, are durable, and figure generously in heavy construction work. They are only slightly porous if at all.

Marble

Marble is metamorphosed limestone in which the component units have lost their identity, just as sand grains lose their identity in changing from sandstone to quartzite. Broadly speaking, the term *marble* may include magnesium carbonate of *dolomitic limestone* with the usual calcium carbonate of the *typical limestone*.

When pure, marble is white; the black flecks so common in marble used in tombstones may be graphite metamorphosed from organic material originally bedded in the calcium carbonate that produced the metamorphosed limestone. Marble does not split in a plane as do the schists. It polishes beautifully but acid in rain may cause it to weather badly in a few generations.

Marble quarries are widely distributed over the earth and well distributed over the mountainous portions of the United States. Marble is quarried in such widely separated areas as Washington, California, Georgia, and Vermont. In comparison with such metamorphic rocks as the quartzites, it is cut readily. Impurities in it are responsible for more varieties than can here be mentioned.

Marble is a superior and popular building stone. It is one of the commonest stones used for monuments but an old cemetery will show how durable it may be over a span of a century. It is also used in industry, in road building, and in the arts. In modern building, it is being replaced to some extent by commercial substitutes made of ground materials cemented into shape.

Products of Metamorphosed Organic Materials

Anthracite coal is bituminous coal that has been subjected to heat and pressure and so metamorphosed in the process that the individual plant elements have lost their identity and the fracture is conchoidal. Flame from such coal is lower and cleaner and possibly hotter, and anthracite fires require less frequent attention. Anthracite has a high luster and is hard and always black.

Organic material under certain conditions, usually associated with marine situations, undergoes a series of changes that yield petroleum, natural gas, tar, paraffin, asphalt, crude oil, and other common substances. It is believed they were formed from life on sea bottoms that accumulated and was held in the muds that became shales.

Asphalt is a solid residue such as is found in California and Texas, left when some of the gases and oils have been removed from crude petroleum. Pennsylvania oils usually have as a base paraffin rather than asphalt. Oil, being lighter than water, rises above it and is therefore often found held captive above water underground.

The importance of anthracite, petroleum, tar, asphalt, and similar material is too obvious to need review. Even graphite, used either as a lubricant or in some electrical equipment, jet used in making ornaments, or diamonds used for cutting hard materials may be a part of a cycle in which living things may have had a part. Unfortunately, most of these valuable resources are nonrenewable.

Slate

Metamorphosed shales split more perfectly than do the original shales and may make slates of one type or another. Because of the great variety of minerals in muds and clays we can expect a great variety of metamorphosed shales. They differ from the sandstones and the quartzites in that the particles are too small to be identified by the eye.

In addition to slates composed of clays, there are those with varying amounts of calcite, magnetite, chlorite, graphite, and so on; some have varying amounts of sandy materials mixed with the finer units. Other slates have silica, lime, or bituminous materials and are named accordingly.

Colors of slates are usually determined by the materials originally in them. Greens come from chlorides; reds and blues, from iron compounds; blacks, from carbonaceous material; and pale colors possibly from siliceous materials. A slate may become a *mica schist* if metamorphism continues, or in an intermediate state, with fine foliation and lustrous cleavage surfaces, *phyllite*.

Slates were used in schools in the early days and to some extent are still used as blackboards; however, it is now common to use slate wastes or even to grind slaty materials and cement them to make the products available commercially. Raw slate shingles have been largely replaced by shingles made of slate waste ground and cemented. These wastes are used in fire prevention.

IGNEOUS ROCKS

Granite

Light-colored rocks with a salt-and-pepper effect. Heavy. With mineral units varying in size from over 1 ft. in diameter to under $\frac{1}{2}$ in. Composed primarily of quartz, orthoclase feldspar, and mica. There may or may not be hornblende or augite. *Granite* is a general name applied to light-colored granular rocks of this general composition and nature. Acidic.

In *giant-sized granites* the mineral units are over 1 ft. in diameter; in *coarse-grained*, they are from 1 ft. to $\frac{1}{2}$ in.; in *medium-grained*, from $\frac{1}{2}$ to $\frac{1}{4}$ in.; and in *fine-grained*, under $\frac{1}{2}$ in. Granites may also be classified according to the kind of mica present as *muscovite* or *biotite*. The related fine-grained, dense rock with alkali feldspar and quartz is *ryholite*, a variety of *felsite*; if porphyritic, it is *ryholite-porphyr*.

Granites are formed deep in the earth and become exposed gradually by the erosion of mountaintops or otherwise. When they disintegrate with weathering, the mica is weathered first, then the feldspar. These contribute to the formation of muds and clays, leaving the quartz to form sand. Granites do not weather rapidly and are resistant to the acid action that affects marble. Felsites are shallow rocks.

Granites occur in great masses as bed-rock or in fragments that have been broken loose and rolled into cobbles, boulders, or pebbles. They are cut with difficulty, take a good and permanent polish, make excellent building stones of a permanent nature, and are used in buildings, walls, roads, for fill, and so on. Abundant.

Syenite

Light-colored rocks with a salt-and-pepper effect, like a granite without any quartz in it. They are composed essentially of orthoclase feldspar and mica with or without hornblende or augite. Syenite may have many other minerals than those mentioned as typical, including plagioclase feldspar, magnetite, and apatite. Acidic.

In syenite, the mineral units are usually large enough to be distinguished by the naked eye and the coarseness of the rock as a whole is essentially as outlined under the classification of granites. If the plagioclase feldspar approaches in amount the orthoclase present, the rock is a *monzonite*; if it exceeds the orthoclase, the syenite becomes a *diorite*, another deep-seated rock.

Syenite was formed in batholiths under mountain ranges; it becomes exposed only gradually through the erosion of softer overlying materials. It commonly remains as an erect uneroded core in the form of a batholith. Since, like granite, it is intrusive, it may have metamorphosed somewhat the rocks into which it made its way or which were adjacent to it. If it is dense, it tends to become *trachyte*, a type of felsite.

Syenites are not so common as granites. They may be more easily carved and worked than granites. Syenite finds general use as fill and in road making but since it is less abundant than granite it is naturally less well known.

Diorite

Medium-dark-colored rock, granular, with salt-and-pepper effect. Like syenite, it lacks quartz. In diorite, plagioclase feldspar replaces the orthoclase feldspar that is essential in granite and in syenite. Mica should usually be present, and there may or may not be hornblende. Of course, other minerals may be present to some degree; among these commonly are apatite and magnetite. If quartz should occur the mixture is called *quartz diorite*. Basic.

As in syenite, there is variation in size of the mineral units, and the degree of coarseness is essentially that described under granite. A diorite that is dense, stony, not glassy or dark gray, green, or black is called *felsite* or *dacite* (lime-soda feldspar and quartz) and one that is porphyritic is *dacite porphyry*. *Dacite* is a shallow rock. *Hornblende diorite* is darker.

Like granite and syenite, diorites originate deep in the earth and reach the surface by gradual erosion of the covering rocks. Since they have intruded into the covering rock blanket, they may appear as batholiths or mountain cores in old mountain ranges. Augite may be present in considerable proportion; if this exceeds the hornblende the rock becomes *gabbro*. Weathering is slow.

The uses of diorite are much the same as those of syenite. Diorites are much less common and widely distributed than are the granites although they may be found in the eastern United States, Canada, and the Rocky Mountain areas. As is the case with all rocks, there are intergradations with other kinds due to the presence of different minerals.

Gabbro

Dark rocks with a coarse salt-and-pepper effect are known as *gabbro*. Composed primarily of plagioclase feldspar and pyroxene. If olivine is also present, then the gabbro is classified as *olivine gabbro*. A dense gabbro with unusually small crystals is classified as *diabase*. As in syenite and diorite, the quartz to be found in granite is missing and the rock may be correspondingly heavy in weight. Basic.

While gabbro is made essentially of plagioclase feldspar and pyroxene, it may be classified on the basis of the relative abundance of the two. Thus a gabbro with a great predominance of plagioclase feldspar is called *anorthosite*; one with a predominance of pyroxene is called *pyroxenite*. Other minerals may appear together with these in varying numbers and abundance. Magnetite is a common addition.

Gabbro, like granite, diorite, and syenite, is usually formed deep in the earth and has cooled slowly over great periods of time. However, in the case of gabbro, some of the upper material may on occasion extrude itself from the protective blanket, cool quickly, and appear as a denser rock. This is known as *trap rock*. It, of course, is much finer grained than the typical gabbro.

These dark rocks are, where abundant, used commonly as building stone, in road making, for heavy fill, and for similar important purposes. Ordinarily, they do not appear in the abundance characteristic of the granites.

Peridotite

Dark rocks. While of the igneous rocks so far considered quartz was present only in the granites, feldspar in one form or another was present in all. If we eliminate the feldspar and the quartz as constants and find a rock that always has augite in it and may or may not have hornblende and mica, we have a *peridotite*. The addition of other minerals is possible.

Coarse-grained peridotite with olivine in it is still considered as peridotite. Without olivine, it may be classified as *pyroxenite* even though the presence of feldspar in peridotite is not standard. A pyroxenite may be composed of but one mineral if that mineral is of the pyroxene group—minerals like augite, enstatite, or hypersthene, some of which are not here considered.

Peridotite and pyroxenite are intrusive rocks like granite, syenite, and diorite. As such, they are formed deep underground and exposed to the surface by a slow removal of the covering materials. Exposed to the weather, they gradually disintegrate but usually more slowly than did the rocks that were immediately adjacent to them. Some are closely associated with extrusive rocks such as *lavas*.

Neither peridotite nor pyroxenite is, generally speaking, common, and for the average reader of this book they need not be considered. Even where they are present, they are more likely to be found in small, rather limited areas than in extensive formations. They may be used for coarse fill and for general rock purposes much as are the other igneous rocks here mentioned.

EXTRUSIVE ROCKS

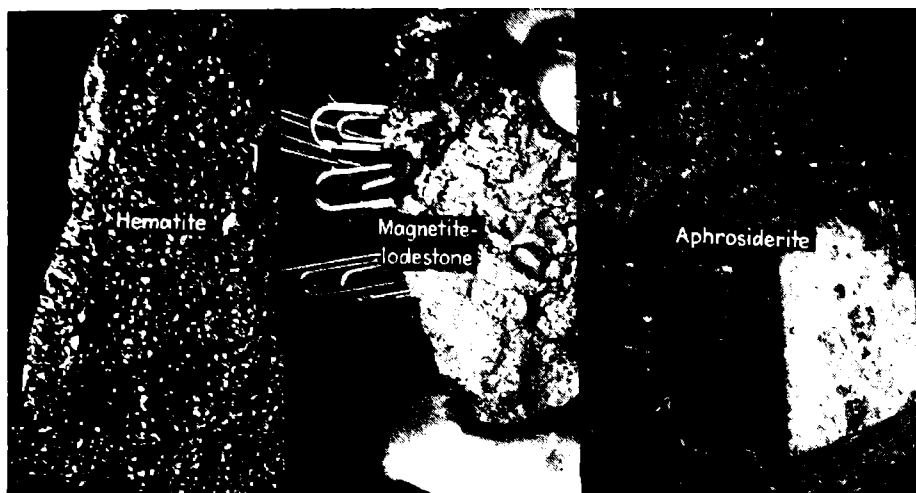
Obsidian, Pumice, Pitchstone, Scoriae, Trachyte

Glassy rocks, either light or dark in color or mixed; generally if broken they may have a rounded or conchoidal fracture. Some are dull while others have a distinct luster. Chemical composition varies with the different kinds but crystals are absent or too small to be detected as they are in other rocks here discussed.

Most characteristic of these rocks is *obsidian*, which looks much like a hard, colored glass that shows shell-like ridges on the breaks. It has a hardness of 6 and may vary from black through green or red to a translucent condition. *Pitchstone* has a more resinous luster and *pearlstone* or *perlite* has definite rounded masses that persist.

Where gases formed cavities in cooling lavas, we find different kinds of extrusive rocks. If the cavities are small and uniform, we get glassy vesicular *pumice*; if they are large, *scoria*, the former often being light and the latter dark. If the cavities have been filled with other minerals, we get *amygdaloid*. All these are lavas that have cooled quickly either as a result of volcanic explosion or by pouring out.

The color of these extrusive rocks is determined largely by the chemical and physical nature of the rocks. Fine ash or *tuff* or *volcanic ash* represents the finer dusts that may be suspended in the air longer than most extrusive materials.



HEMATITE

Iron Ore, Sesquioxide of Iron

Fe_2O_3 . Metallic iron, 70%

Specific gravity: 4.9–6.5

Hardness: 5.5–6.5

Streak: Dark red, cherry red, or brown

Luster: Brilliant metallic to submetallic to dull

Cleavage: None

Fracture: May show a fine granular surface or be coarser

Color: Steel-gray to iron-black, to red, to red-brown, to black

Fusibility: 5–5½. Burned on coal becomes magnetic and with soda may become a magnetic powder. Gives little or no water in closed tube and becomes black and magnetic under blowpipe flame

Soluble in strong hydrochloric acid but action is slow. Varieties include *Cinabar iron ore* (red); *red hematite* (soft ochraceous powder); *specular hematite* (brilliant crystals); and others

Crystals not common in ores but when found are rhombohedral

Found with other iron ores, more particularly in turgite and limonite, in sedimentary and metamorphic rocks

A chief source of iron. Metallic iron has a specific gravity of 7.8, a melting point of 1520°C, a boiling point of 2450°C. Commonly alloyed with chromium, manganese, molybdenum, tungsten, vanadium, silicon, nickel, and cobalt. Carbon is added in making steel. Carbon steel softens or loses its temper at 500°F.; in steels containing tungsten and cobalt this is raised to 1000°F. Steel is probably the basic metal of our modern civilization with the automobile, railroad, and construction accounting for most of the demand.

MAGNETITE

Magnetic Iron Oxide

Fe_3O_4 . Metallic iron, 72.4%

Specific gravity: 4.9–5.18

Hardness: 5.5–6.5

Streak: Black

Luster: Metallic to submetallic to dull

Cleavage: Not distinct; parallel to octohedron, may be distinct

Fracture: Uneven, conchoidal, brittle

Color: Iron-black

Fusibility: 5–5½. Hard to fuse; in open flame is oxidized to nonmagnetic hematite, magnetic before heating

Soluble in hydrochloric acid

May be massive, with or without laminated structure, or as sand

Found mostly in metamorphic rocks or black sands associated with apatite, hornblende, feldspar, chlorite, pyrite, zircon, ilmenite

See hematite for characteristics of metallic iron. Magnetite is used somewhat as a source of metallic iron. The variety known as *lodestone* (shown above) is a natural magnet.

SIDERITE

Spathic Iron, Black Band Iron, Clay Ironstone

FeCO_3 . Iron, 48.3%

Specific gravity: 3.8–3.9

Hardness: 3.5–4

Streak: White to pale yellow

Luster: Vitreous to pearly and translucent to opaque

Cleavage: In 3 directions, rhombohedral, perfect at 73° and 107°

Fracture: Conchoidal and uneven

Color: Gray, yellow, brown, black, or white, often discolored

Fusibility: 4½–5. Becomes black and magnetic when heated sufficiently, breaks down and yields carbon dioxide, but fuses only with difficulty

Dissolves with conspicuous effervescence in hot hydrochloric acid; solution has the reaction for ferrous iron

Crystallization: hexagonal, rhombohedral, or granular

Found in veins, beds, concretions in shale, limestone, coal; associated with minerals of silver, pyrite, cryolite, and dolomite

Sometimes used as an iron ore and for this purpose is mined in Ohio and in Pennsylvania. It hardly compares with hematite and magnetite as a source of iron. A clayey iron carbonate of siderite is used in the making of hones for sharpening steel tools.



IRON PYRITE

Fool's Gold

FeS2. Sulfur, 53.3%; iron, 46.7%

Specific gravity: 4.9–5.2

Hardness: 6–6.5

Streak: Greenish black to brownish black. Marcasite: yellow

Luster: Metallic, opaque

Cleavage: None, brittle. Marcasite: cleavage in 2 directions

Fracture: Uneven

Color: Pale to brass yellow, tarnishes brown, sometimes iridescent

Fusibility: $2\frac{1}{2}$ –3. Becomes magnetic in open flame. Burned on coal, it gives a blue flame from the sulfur. Burned in a closed tube, there is a sublimate of sulfur and a magnetic residue

Completely soluble in cold nitric acid but not soluble in hydrochloric acid. In marcasite, sulfur separates in cold nitric acid

Crystallization: In form of isometric cubes, often with striations

Found in various rocks, often with gold and silver ores, in schists, concretions, clay, shale, and coal

Used primarily as a source of sulfur and in the manufacture of sulfuric acid, in the manufacture of paper; the crystals have uses as radio detectors. Iron pyrite is not a common source of metallic iron.

CHALCOCITE

Copper Glance

Cu2S. Copper, 79.8%; sulfur, 20.2%

Specific gravity: 5.5–5.8

Hardness: 2.5–3, for crystals

Streak: Black to lead-gray

Luster: Metallic in crystal; dull in soft forms

Cleavage: Poor

Fracture: Conchoidal, brittle

Color: Black to lead-gray; may be blue or green-coated

Fusibility: $2\frac{1}{2}$. Gives off sulfur fumes heated in open tube. Melts to sputtering globule on charcoal. After roasting and moistening with HCl, gives a copper flame reaction

Hot acid attacks copper freely but cold nitric acid or sulfuric acid has little effect

Crystallization: Usually massive, orthorhombic

Found with pyrite, chalcopyrite, hematite, galena, and similar ores

Copper metal has specific gravity of 8.4–8.9, melts at 1080–1200°C., boils from 1980–2310°C. Alloyed with zinc, makes *brass*; with tin and zinc, *bronze*; with zinc and nickel, *German silver*; with aluminum, *aluminum bronze*. Next to silver, copper is the best conductor of electricity. Used in electrical equipment, in making wire and wire cloth, in building construction, in automobiles, in ships, and in ammunition, in paints, printing, plating.

CHROMITE

Chromium Trioxide, Chromium Ore

FeCr2O4. Chromium trioxide, 68%

Specific gravity: 4.3–4.6

Hardness: 5.5

Streak: Dark brown

Luster: Dull to submetallic to opaque

Cleavage: None or indistinct, parting in 4 directions, $70\frac{1}{2}^\circ$ and $109\frac{1}{2}^\circ$

Fracture: Uneven, conchoidal

Color: Iron-black to brownish-black

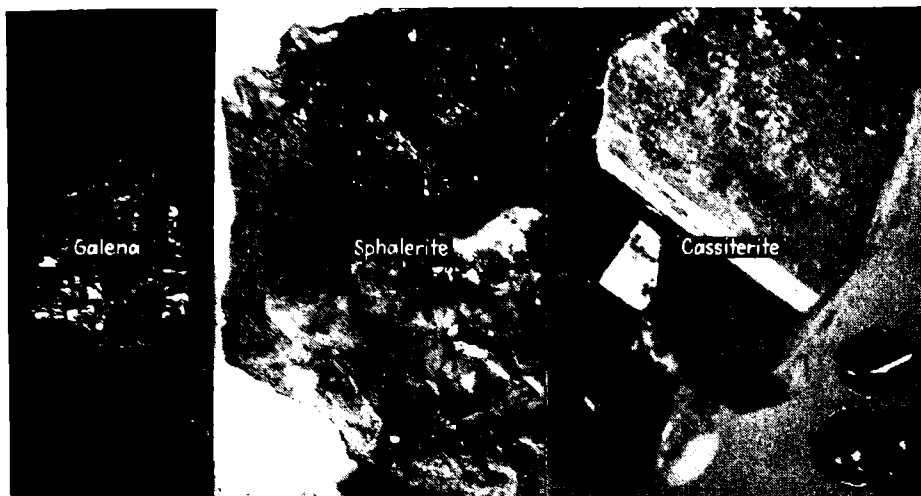
Fusibility: Almost infusible. Edges rounded in the reducing flame and some magnetic properties may develop. Decomposed by fusion with potassium or sodium bisulfate

Insoluble in acids

Crystallization: Usually massive or in granules and compact

Found in peridotite, serpentine, in black sands, and in platinum placers associated with olivine, talc, chlorite, and magnetite

Chromium metal has specific gravity of 6.7–7.1, melts at 1650°C., boils at 2200°C., becomes magnetic at -15°C ., is harder than iron or cobalt. Used principally in alloy steels to make them harder even though chromium may be only 1% of the finished steel. Stainless steel is chromium steel in which the chromium is about 12–30%. Chromium is also used in furnaces, in plating plumbing fixtures, in paints, dyes, and printing. Because of its improvement of steel and the restricted existence of the ore, it is considered a strategic mineral. Rhodesia, Turkey, the Philippines, and Africa are leading producers.



GALENA

Galena, Lead Glance

PbS. Lead, 86.6%; sulfur, 13.4%

Specific gravity: 7.4-7.6

Hardness: 2.5-2.75

Streak: Pure lead-gray

Luster: Metallic, opaque

Cleavage: In 3 directions, perfect, 90°, brittle

Fracture: Conchoidal, flat, and even

Color: Lead-gray

Fusibility: 2. Burned on charcoal, forms lead globules and a yellow sublimate bordered by white; gives off sulfur fumes in open tube

Soluble in strong nitric acid leaving a white powdery precipitate; all lead salts are poisonous

Crystallization: isometric, crystalline, or in granules

Found in iron deposits associated with sphalerite, pyrite, barite, chalcopyrite, fluorite; some lead ores rich in silver

Metallic lead has specific gravity of 11.35, a melting point of 327°C., and a boiling point of 1525°C. Nearly 90% of the lead in commercial use is in storage batteries; other important uses including roofing, plumbing, paints, cable covering. Alloyed with tin and antimony it makes *type metal*; with tin, *solder*; with tin, antimony, or bismuth and copper, *pewter*. Lead is used as a low-friction metal in heavy bearings.

SPHALERITE

Zinc Ore, Black Jack, Zinc Blende

ZnS. Zinc 67% and iron, manganese, cadmium, or others

Specific gravity: 4

Hardness: 3.5-4

Streak: Brown to yellow to white

Luster: Resinous to adamantine

Cleavage: Perfect; dodecahedral, in 6 directions, 60°-90°-120°

Fracture: Conchoidal, brittle

Color: Yellow, brown, black, green, red, or even white

Fusibility: 5. Magnetic in oxidizing flame. Greenish to deep-green flame in reducing flame with soda on coal. Zinc can be rolled into sheets

Decomposed by hot hydrochloric acid. Zinc is soluble in soda and potash and in dilute nitric acid

Crystallization: Usually granular and compact, tetragonal; sometimes amorphous

Found with lead mineral, pyrite, chalcopyrite, fluorite, siderite, and with silver and gold ores

Zinc metal has specific gravity of 6.9-7.1, melts at 419°C., and boils at 918°C. Alloyed with copper makes *brass*; with tin and copper, *bronze*; with nickel and copper, *German silver*. Is brittle at red heat but malleable and ductile at low liquid temperature. About half of zinc produced is used in rubber industry. Sulfuric acid is a by-product of smelting of sphalerite. Zinc is used in galvanizing iron, in solder, in storage batteries, and in dyes.

CASSITERITE

Tin Stone, Tin Ore

SnO₂. Tin, about 78.6%

Specific gravity: 6.8-7.1

Hardness: 6-7

Streak: White to grayish-brown

Luster: Adamantine, greasy, dull, transparent to opaque

Cleavage: Indistinct, brittle, poor

Fracture: Usually uneven, but sometimes smooth, subconchoidal

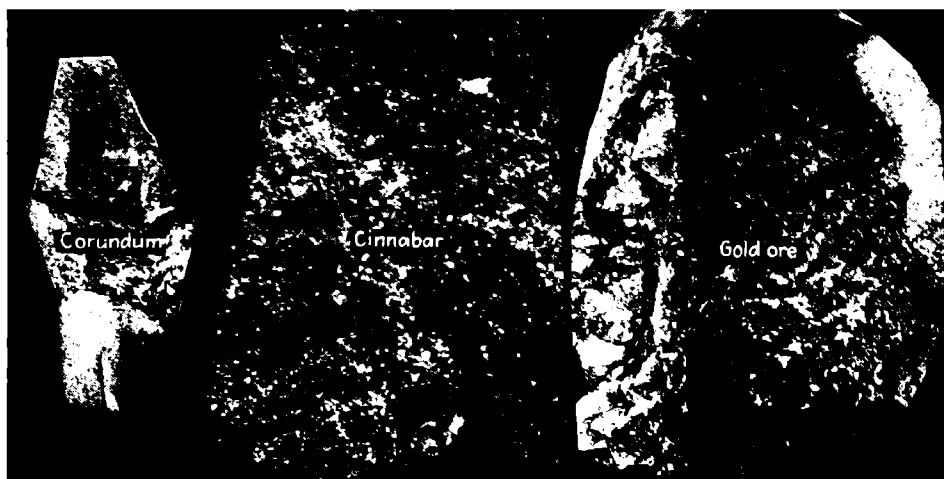
Color: Variable from brown to black, or rarely yellow, red, gray, or white

Fusibility: With intense heat with soda on charcoal leaves the white sublimate SnO₂. When fused with soda, sulfur, and charcoal, gives metallic globule with yellow coating. Yields metallic tin with zinc and hydrochloric acid. When the tin is rubbed, it yields a characteristic color. Acid acts slowly on tin. Ore is decomposed by fusion with potassium hydroxide in nickel crucible

Crystallization: Tetragonal with thick prismatic crystals

Found in granite, gneiss, or pegmatite, commonly massive or in kidney forms or in rounded granules (see cut) as stream tin in placers

Metallic tin is weak, silvery white, with specific gravity of 7.3, melts at 232°C., begins to volatilize at 1600°C. and to boil at 2270°C. At 100°C., it is highly ductile and may be made into wire but at -39°C. for at least 14 hours it becomes brittle. Not affected by exposure to air; a poor conductor of electricity and of heat. Used mostly in plating iron to prevent rust for use in cans, roofing, and utensils. A common alloy in *white metal*, *solid silver*, *babbitt*, *type metal*; used in dyes, polishing mixtures, and as filler for silk.



CORUNDUM

Sapphire, Emery, Ruby

Al₂O₃. Aluminum, 52.9%

Specific gravity: 3.9–4.1

Hardness: 9

Streak: Uncolored

Luster: Vitreous to pearly and adamantine

Cleavage: Basic and rhombohedral, with twinning common

Fracture: Conchoidal to uneven

Color: Gray, yellow, brown, red, white, blue

Fusibility: Decomposed by fusion with potassium hydroxide in a nickel crucible. Infusible and unaltered by soda. Powder becomes blue after being heated a long time with cobalt nitrate

Dissolves slowly in borax and salt of phosphorus to make a clear glass that is colorless when no iron is present. Emery contains magnetite, hematite, or spinel

Crystallization: Hexagonal, with pyramidal and rounded forms common

Found in crystalline rocks such as gneiss, granite, schist, slate, and limestone associated with chlorite, tourmaline, and cyanite

Corundum and emery are among the best abrasives for whetstones, grinding wheels for polishing, stone cutting, and glass etching. Gems of the same material are the transparent *blue sapphire*, the green *Oriental emerald*, the yellow *Oriental topaz*, and the red *ruby*. *Synthetic rubies* are made of the powder formed in cutting natural rubies. *Carborundum* is made basically of corundum.

CINNABAR

Mercury Ore

HgS

Specific gravity: 8.1–8.2

Hardness: 2–2.5

Streak: Scarlet

Luster: Adamantine, transparent to opaque

Cleavage: Poor, in 3 directions, prismatic, at 60° and 120°

Fracture: Uneven

Fusibility: 1½. Volatile, heated in a closed tube forms a black sublimate; 1 part dry cinnabar to 4 parts dry soda heated gently in a closed tube yields minute globules

Clean copper dipped in a mercury solution yields a silvery metallic mirror coating

Found in veins in sandstone and limestone associated with pyrite, marcasite, barite, quartz, sulfur, and opal. Important mines in Spain

Metallic mercury has specific gravity of 13.595. It solidifies at –38.37°C. and boils at 360°C. Solid mercury is malleable, ductile, can be sliced, and has a specific gravity of 14.19. Mercury has a uniform expansion and contraction with temperature change and unites readily with many other metals. It is used in making mirrors, thermometers, vapor lamps, in electrical equipment, in medicine, in the extraction of heavy metals like gold from pulverized mixed ores. It was important in making of war equipment and is considered a strategic mineral.

GOLD

Gold

Au

Specific gravity: 15.6–19.3

Hardness: 2.5–3

Streak: Yellow-gold or lighter

Luster: Metallic

Cleavage: None

Fracture: Hackly

Color: Golden-yellow or paler

Fusibility: 2½–3. Fuses at 1100°C.

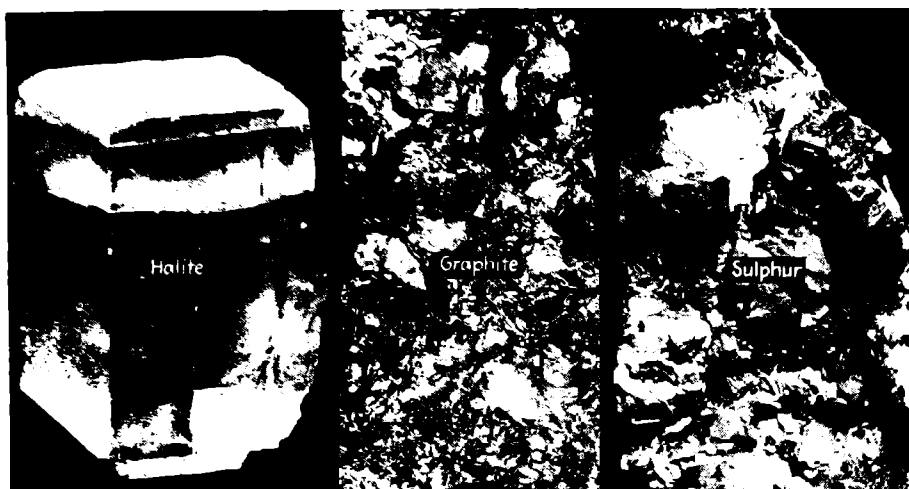
Highly ductile and malleable at ordinary temperatures; 1 gram can be drawn into 2 miles of wire and 1 oz. beaten to cover 300 sq. ft.

Not affected by any single acids, but aqua regia and telluric acid will dissolve it. Water with iodine, chlorine, bromine, or fluorine will attack it

Crystallization: Rarely in perfect form. Isometric

Found scattered in plates, scales, and grains in ore rocks whether igneous, metamorphic, or sedimentary

Pure gold has a specific gravity of 19.32. It melts at 1063°C. and boils at 2500°C. It is greenish, may be welded, is a good conductor of heat and electricity but not so good as silver, and alloys freely with a number of other metals. It is used in coins and in jewelry. Gold coins are generally 9 parts gold and 1 part copper. *White gold* is an alloy with platinum, silver, or nickel and zinc; *purple*, with aluminum; *blue*, with iron or steel; *red*, with copper; and *green*, with silver and cadmium or with silver, copper, and cadmium. Gold used to be considered evidence of industry and of a sound economy.



HALITE

Salt, Sodium Chloride

NaCl

Specific gravity: 2.1-2.6

Hardness: 2-2.5

Streak: White

Luster: Vitreous

Cleavage: In 3 directions, cubical

perfect

Fracture: Conchoidal, brittle

Color: Colorless, white, red, blue, or yellow

Fusibility: 1491. In flame, gives a persistent yellow color that is very brilliant

Is readily dissolved in water and of course has a salty taste

Crystallization: In isometric cubes

Found in sedimentary rocks, usually in strata, and at edges of bodies of evaporating salt water associated with gypsum

Salt has a variety of uses as a preservative of food, in the making of glass and of explosives, in dyes, in metallurgy, in making baking soda, sal soda, caustic soda, washing soda, and in medicine. It is used to melt snow, in refrigeration processes, to absorb moisture from atmosphere, in softening water, and in many other ways.

GRAPHITE

Black Lead, Plumbago

C. Often with iron and clay

Specific gravity: 1.9-2.3

Hardness: 1

Streak: Grayish-black and shiny

Luster: Opaque and metallic

Cleavage: Perfect, in 1 direction. Feels

greasy

Fracture: Thin, flexible plates

Color: Iron-black to dark steel-gray

Fusibility: Infusible before blowpipe

but burns at high temperatures

Insoluble in acids

Crystallization: In 6-sided tabular crystals. Easily separated and broken

Found in masses or flakes in beds or seams in schists, limestones, granites, or sometimes in clay rocks

Used as lubricant, in making lead pencils and polishes, for prevention of oxidation and wearing of metal surfaces, as a filler for dry batteries, in pipe cements, in much electrical equipment, in manufacture of bleaching powders and of alkalies, in the making of crucibles for electric furnaces, in foundry molds, in electrotyping, and in glazing.

SULFUR

Sulfur

S

Specific gravity: 2.05-2.09

Hardness: 1.5-2.5

Streak: White

Luster: Resinous, transparent to translucent

Cleavage: Poor

Fracture: Uneven to conchoidal, brittle, cuts poorly

Color: Sulfur-yellow to gray, brown, green, or red

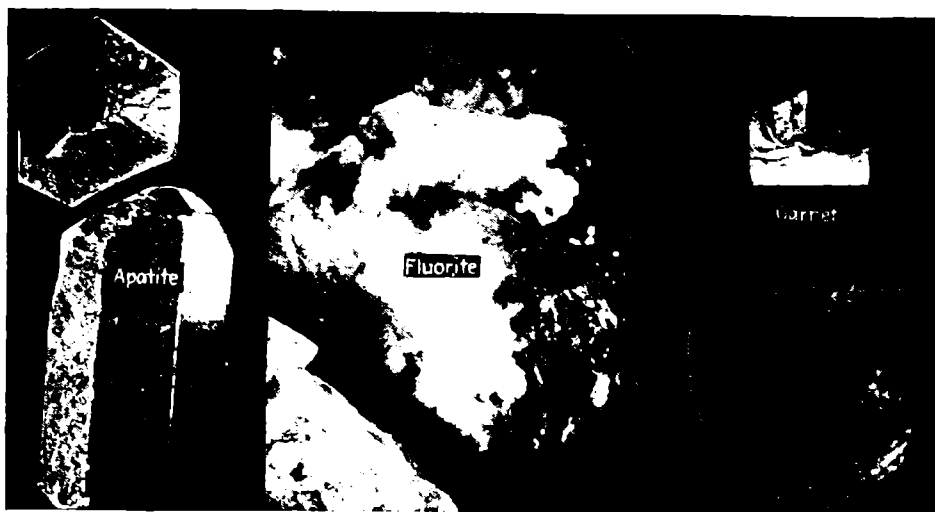
Fusibility: 1. Burns freely with a bluish flame giving off fumes of sulfur dioxide

Not soluble in water or the usual test acids but is soluble in carbon bisulfide

Commonly in masses but may be in orthorhombic pyramids or tablets

Found in combination with ores bearing iron, copper, lead, zinc, or in a pure form

Sulfur melts into a yellow sticky liquid at 160°C. but begins melting at 108°C. It burns at 270°C. with a bluish flame. Sulfur is used in many commercial ways including the manufacture of sulfuric acid, paper, explosives, fireworks, matches, insecticides, rubber, bleaching mixtures, in medicines, and as fertilizer. In time of war, it is necessary for the manufacture of much ammunition.



APATITE

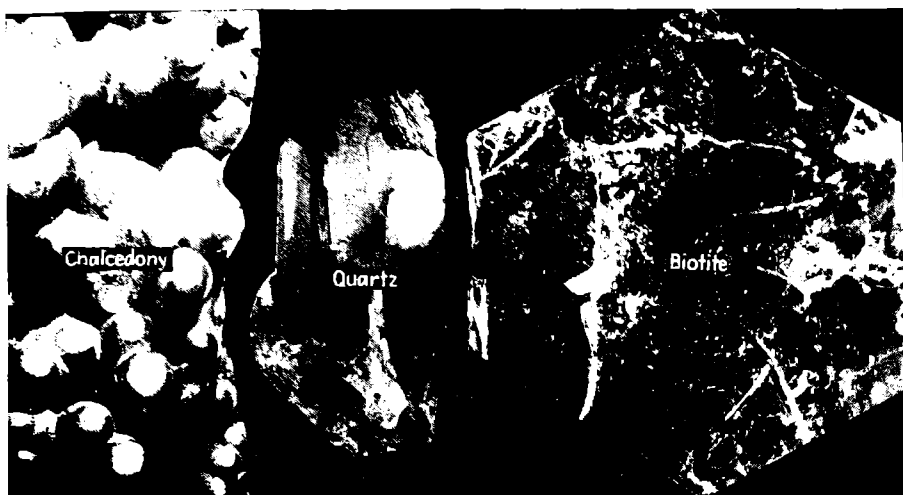
$\text{Ca}_5(\text{F}, \text{Cl})(\text{PO}_4)_3$
 Specific gravity: 3.17–3.23
 Hardness: 5
 Streak: White
 Luster: Vitreous to somewhat resinous
 Cleavage: Poor, basal
 Fracture: Conchoidal to uneven and brittle
 Color: Green to blue-green, to brown, to flesh-colored, to yellow
 Fusibility: About 5. Fuses in blowpipe flame at thin edges giving orange color to flame, but if moistened with sulfuric acid the flame is blue-green.
 Soluble in nitric acid and in hydrochloric acid; with sulfuric acid yields the precipitate calcium sulfate
 Crystallization: Hexagonal crystals or prisms with pyramids at end
 Found with many kinds of igneous rocks, in metamorphic rocks, and in limestones and shales, widely distributed. Common in veins
 A source of phosphorus that has many uses, particularly as a basis of fertilizer; closely resembles phosphate rock and superphosphate materials found in them. Pure metallic phosphorus is white to transparent, waxy, with specific gravity of 1.8 at 0°C. It melts at 44.3°C. and boils at 287°C. In moist air, it bursts into flame at 34°C. Related red phosphorus flames at 350°C. Phosphorus was used extensively in time of war for flares and for other purposes.

FLUORITE

Fluorspar, Calcium Fluoride
 CaF_2 . Fluorine, 48.9%
 Specific gravity: 3.01–3.25
 Hardness: 4
 Streak: White
 Luster: Vitreous and splendid, transparent to opaque
 Cleavage: Perfect, in 4 directions, octohedral
 Fracture: Conchoidal to splintery, brittle
 Fusibility: 3. Gives calcium flame of red and forms an alkaline enamel when fused in blowpipe flame; in closed tube, glows and lies to pieces. Fused with a salt of phosphorus, it etches glass
 Mixed with sulfuric acid yields hydrofluoric acid gas or flames that may etch glass
 Crystallization: Isometric, cubes or approximate cubes, massive
 Found in beds, seams, or veins in gneiss, slate, sandstone associated with ores of silver and gold, with quartz, calcite, and others
 Fluorine is a greenish-yellow gas that boils at -18°C . and has a specific gravity of 1.14. Hydrofluoric acid is used as a wood preservative, in the gas freon used in mechanical refrigerators, in the refining of gold, silver, copper, and lead, in the manufacture of aluminum from bauxite, in glass making, and in the electrical industry.

GARNET

Orthosilicates of different metals
 Specific gravity: 3.15–4.3
 Hardness: 6.7–7.5
 Streak: White
 Luster: Vitreous in crystals; resinous when massive
 Cleavage: No true cleavage
 Fracture: Uneven to subconchoidal
 Color: Red, yellow, brown, green, black, white
 Fusibility: 3–4. Fuses variously depending on the kind; uvarovite almost infusible, while almandite yields a magnetic globule; decomposed by fusion with sodium and potassium carbonate
 Most varieties react like iron, and all except uvarovite are decomposed by hydrochloric acid, leaving a gelatinous silica
 Crystallization: Isometric, dodecahedrons and trapezohedrons
 Found mostly in metamorphic rocks but also in schists and gneisses with crystals relatively common, or it may be granular or massive
 Used commercially as an abrasive, but the finer stones are of gem quality including the *red carbuncle*, the rose and purple brilliant *rhodolite* and *uvarovite*, which take a high polish and are of various colors. Their powders are used in tooth pastes, in leather polishes, and in wood polishing.



CHALCEDONY

A Fine Quartz

SiO_2

Specific gravity: 2.65

Hardness: 7

Streak: White

Luster: Vitreous, waxy, dull

Cleavage: None, brittle and tough

Fracture: Conchoidal

Color: White, gray, brown, to black

Fusibility: Fuses with equal amounts of soda on platinum wire to form a clear glass

Differs from ordinary quartz crystal in that it is not in the form of the typical hexagonal prisms but is usually with rounded surfaces

Crystallization: Usually dense

Found in thin seams and bands or as crusts inside caves or cavities; often found by breaking cobbles

Many are almost of gem quality.

Agate is variegated, banded, or mottled chalcedony; *amethyst*, purple or blue; *bloodstone*, red; *cat's eye*, opalescent and variable; *heliotrope*, green dotted with red; *jasper*, yellow, red, or brown; and *moss agate*, with moss-like discoloration. *Flint* is an impure chalcedony formed in concretions and *chert* impure chalcedony that has a splintery fracture. *Opal* is a variegated chalcedony and *avetized wood* is formed when chalcedony has replaced wood to the finest detail. Chert, like flint, is formed in nodules

Chalcedony was the basis of the Stone Age civilization (see p. 608) much as iron is of that today.

QUARTZ

SiO_2

Specific gravity: 2.65

Hardness: 7

Streak: White

Luster: Vitreous, greasy

Cleavage: Indistinct and brittle

Fracture: Conchoidal

Fusibility: Fuses with difficulty. With equal amounts of soda on platinum wire fuses to form a clear glass

May be etched by hydrofluoric acid, is slightly soluble in water but more particularly in alkaline waters

Crystallization: Usually in prismatic hexagonal rhombohedral form

Composes about 12% of the mineral matter of the earth's crust and is possibly our most abundant mineral

Quartz glass permits passage of ultraviolet light. Ordinary glass also is largely quartz. Rock crystals are essential in radio communication. The many varieties include *rose quartz*, *smoky quartz*, *topaz*, and *opal*.

BIOTITE

Black Mica

$\text{K}(\text{Mg}, \text{Fe})_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$

Specific gravity: 2.7-3.1

Hardness: 2.5-3

Streak: Uncolored

Luster: Pearly or silky to vitreous or splendent

Cleavage: Basal, perfect, in thin plates

Fracture: Ragged, little shown

Color: Green to black

Fusibility: 5. Heated strongly in closed tube, gives off little water.

Blowpipe flame whitens and fuses thin edges. May react as iron after fusion with borax, soda, or salt of phosphorus

Boiling sulfuric acid decomposes it completely, leaving thin silica scales as a residue

Crystallization: Monoclinic, tabular, or in short prisms

Found as the primary material in granites, gneisses, and pegmatites, usually associated with quartz, orthoclase, hornblende, plagioclase, and others

Used somewhat as is muscovite but is less resistant to weathering. Varieties of mica classified chemically include *muscovite*, potassium; *biotite*, magnesium; *phlogopite*, magnesium; *lepidolite*, lithium; *paragonite*, sodium; *lepidomelane*, iron; and *roselite*, vanadium.



MUSCOVITE

White Mica, Potash Mica

$\text{KAl}_2\text{Si}_2\text{O}_{10}(\text{OH})_2$

Specific gravity: 2.75–3

Hardness: 2–2.5

Streak: Uncolored

Luster: Vitreous to pearly or silky

Cleavage: Basal, perfect, splits in radiating lines from point

Fracture: Ragged, poor, tough

Color: Colorless, gray, brown, green-brown

Fusibility: 4½–5. Gives off water if heated in closed tube. Under blow-pipe flame, whitens and fuses on the thin edges to a yellowish glass

Insoluble in acids, not decomposed even by boiling in concentrated sulfuric acid

Crystallization: Monoclinic, rhombic, tabular, foliar

Found commonly in granites, syenites, pegmatites, schists, and gneisses associated with quartz, hornblende, orthoclase

Used for windowpanes and for panes in furnaces, also in electrical devices and as a lubricant. It is resistant to weathering and may persist under conditions that eliminate associated minerals in different rocks. Used in fireproof paints and shingles. Sometimes plates of muscovite are found that are a yard across.

ORTHOCLASE FELDSPAR

Right-angled Feldspar

KAlSi_3O_8 or with variations

Specific gravity: 2.57

Hardness: 6

Streak: Uncolored

Luster: Vitreous and often pearly at edge

Cleavage: All orthoclases break at right angles, somewhat pinacoidal

Fracture: Uneven and conchoidal

Color: Flesh-colored, white, red, pale yellow, or gray

Fusibility: 5. Fuses quietly; yields a potassium (pale violet) flame when burned with gypsum; fuses with difficulty to a transparent glass

Insoluble in most common acids

Crystallization: Monoclinic; crystals often prismatic

Found in such igneous and fine-textured rocks as granites, pegmatites, and syenites associated with quartz, muscovite, biotite, hornblende, and plagioclase feldspars. The plagioclase feldspars include soda orthoclase. Orthoclase breaks at right angles while plagioclase breaks at oblique angles. Orthoclase is commonly flesh-colored, while plagioclase is rarely so. Orthoclase is commonest in granites rich in quartz while plagioclase is common in quartz-poor granites. Plagioclase may show fine striae on flat faces.

PLAGIOCLASE FELDSPAR

Soda-potash and Soda-line Feldspars

$(\text{Na}, \text{Ca})\text{AlSi}_3\text{O}_8$

Specific gravity: 2.65–2.67

Hardness: 6–6.5

Streak: Uncolored to white

Luster: Vitreous to pearly, sometimes colored

Cleavage: In 2 directions, basal, perfect, pinacoidal

Fracture: Uneven, may show fine striations on cleavage faces

Color: White, colorless, bluish, green, gray, or reddish

Fusibility: 3½–4. Shows a strong sodium flame when burned with gypsum; fuses quietly to form a clear, glass-like enamel

Is acted on only slightly by acids commonly used for testing minerals.

Related *labradorite*, a plagioclase feldspar, is affected slightly by hydrochloric acid

Crystallization: Usually compact. Crystals triclinic

Found in such rocks as the granites, syenite, and diorites associated with albite and other plagioclases, biotite, and others

The plagioclase feldspars break at oblique angles in contrast with the right-angled breaks of orthoclase feldspars. In the plagioclases, there are potash-soda plagioclases such as *microcline* and soda-line plagioclases such as *albite*, *oligoclase*, *andesine*, *labradorite*, *bytownite*, and *anorthite*, in which the specific gravity increases from 2.62–2.65 in albite to 2.74–2.76 in anorthite.



PYROXENE

A Calcium-magnesium-iron Silicate

A mineral group, $MgSiO_3$

Specific gravity: 3.1-3.6

Hardness: 5-6

Streak: Greenish-brown to gray to white

Luster: Vitreous, dull, submetallic,

transparent to opaque

Cleavage: imperfect, prismatic, in 2 di-

rections lengthwise 87° and 93°

Fracture: Uneven

Color: Light to dark green

Fusibility: 4. Fuses quietly or with little tumescence into a shining black glass that may sometimes be green or brown. If much iron is present, the mass may be magnetic

Chemical differences of related rocks may be reflected in reactions and in behavior in flame. For example, related augite may give sodium flame

Crystallization: Monoclinic, the stout prisms almost rectangular

Found in grains rather commonly in igneous rocks and in crystalline limestone associated with garnet, chlorite, amphiboles, magnetite

A representative pyroxene group includes *enstatite*, *malacolite*, *augite*, *annite*, and *rhodochite*, the latter being important because of its manganese. In the *pyroxenes*, the cleavage faces meet at angles of 87° and 93° while in the *amphiboles* they meet at angles of 56° and 124° . In addition, pyroxene crystals are usually shorter and stouter than the long prismatic crystals of the amphiboles.

HORNBLLENDE

A Calcium-iron-magnesium Silicate

$Ca_2Na(Mg, Fe'')_4(Al, Fe''', Ti)_3Si_8O_{22}(O, OH)_2$

Specific gravity: 3-3.47

Hardness: 5-6

Streak: Gray to dark gray

Luster: Vitreous to pearly on faces of

cleavage. Some silky

Cleavage: Perfect, prismatic in 2 direc-

tions, 56°

Fracture: Uneven and splintery

Color: Dark to bright green, blue-green

to black or brown

Fusibility: 3-4. Fuses to a magnetic mass that is sometimes globular and is usually shiny, usually somewhat intumescent, giving the characteristic sodium flame

Not acted on by acids. May lose luster and become earthy, changing to chlorite, epidote, calcite, and quartz

Crystallization: Monoclinic, prismatic, may be granular

Found commonly in long grains showing parallel sides and ragged ends associated with quartz, feldspars, and biotite

A typical amphibole rock found widely distributed in rocks particularly in New England, the Piedmont area to the south, and the Blue Ridge area. It is a primary rock mineral.

OLIVINE

Chrysolite, Peridot, a Ferromagnesia Silicate

$(Mg, Fe)_2SiO_4$

Specific gravity: 3.2-3.6

Hardness: 6.5-7

Streak: White to yellowish-white

Luster: Vitreous, transparent to trans-

lucent

Cleavage: Basal is distinct and the

pinacoidal less so

Fracture: Uneven and conchoidal,

brittle

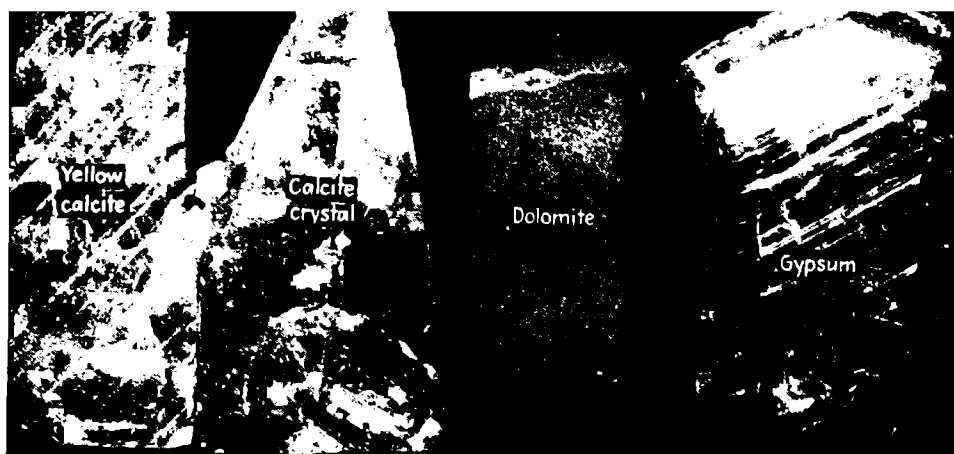
Fusibility: Loses its color but rarely fuses in flame; those forms that are rich in iron, like hyalosiderite, may fuse to make magnetic globules. Gives off little or no water in closed tube

Is decomposed by sulfuric acid and by hydrochloric acid by the separation of the silica

Crystallization: Prismatic or tabular, orthorhombic, granular

Found in gabbro, basalt, and peridotite where it may sometimes represent 50% of the rock; also in schists and in igneous rocks

A representative of the amphibole group of rocks that includes *hornblende*, *actinolite*, *tremolite*, *amosite*, and others. Some forms from the Mediterranean area, such as *peridot* or gem *olivine*, are of gem or semigem quality. It is an important rock in the White Mountains in New England and in parts of the Rocky Mountains and the Cascades.



CALCITE

Calc Spar



Specific gravity: 2.7

Hardness: 3

Streak: White

Luster: Vitreous, dull transparent to opaque

Cleavage: Perfect, in 3 directions, at 75° and 105° , brittle

Fracture: Not common, conchoidal

Color: White, colorless, pale gray, yellow, red, green, blue

Fusibility: Gives a calcium flame when burned with hydrochloric acid, the color being reddish-yellow. Infusible but becomes alkaline

Effervesces with hydrochloric acid, giving off carbon dioxide. Dilute sulfuric acid gives a white precipitate

Crystallization: Varied, usually in hexagonal blocks

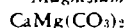
Found in limestones, marble, chalk, and marl, in veins, many of these being almost wholly calcite

Calcite is next to quartz in importance. Geologically, its chief function is in cementing particles of other minerals together. Man uses it for cement, for fertilizer, to flocculate clay bringing particles together permitting a more even distribution of air in soil.

Iceland spar is a colorless, transparent calcite of value in optical instruments and in polarizing microscopes. *Chalk* is soft, white, and earthy. Other forms are *travertine*, *calc-sufa*, and so on.

DOLOMITE

Pearl Spar, Carbonate of Calcium and Magnesium



Specific gravity: 2.8-2.9

Hardness: 3.5-4

Streak: White or gray

Luster: Vitreous to pearly: transparent to opaque or satiny

Cleavage: In 3 directions, perfect 74° and 106° , rhombohedral blocks

Fracture: Conchoidal, uneven, uncommon

Color: White and variously tinted

Fusibility: Gives a yellow to orange flame when burned with hydrochloric acid, is infusible in blowpipe flame

Effervesces in hot hydrochloric acid but not in cold. Dilute sulfuric acid gives a white precipitate

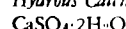
Crystallization: Hexagonal and rhombohedral with the faces curved

Found as dolomitic limestone and marble associated with serpentine, gypsum, talc, and with ores of lead and zinc

Dolomitic limestone is harder and less soluble in acids than true limestones. Burned dolomite produces *quicklime*. Stone is used in building operations as a source of lime, in metallurgy as a source of magnesium, and to some extent in medicine. Because of the abundance of dolomite, it is a dependable source of lime materials.

GYPSUM

Hydrous Calcium Sulfate, Selenite



Specific gravity: 2.3

Hardness: 1.5-2

Streak: White

Luster: Vitreous, pearly, or silky

Cleavage: In selenite and satin spar, easy, in 2 directions

Fracture: Splintery, conchoidal

Color: Colorless, white, gray, pearly, yellow or red

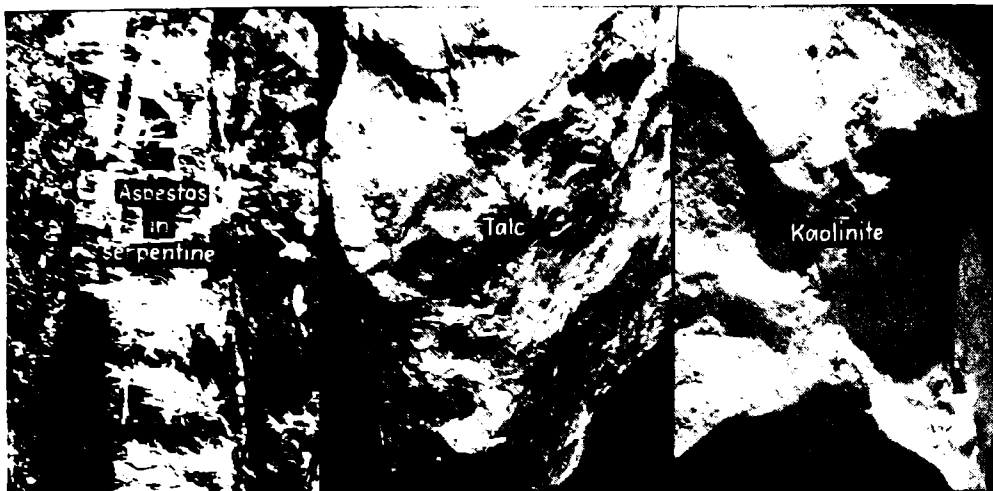
Fusibility: 3. Gives reddish-yellow flame. Heated in closed tube gives off water and becomes opaque and dull. Crushed bead is alkaline

Soluble in hydrochloric acid

Crystallization: Flat, tabular, prismatic, or lenticular, monoclinic

Found in sedimentary rocks or in igneous rocks in seams, beds, and sheets with shale, limestone, rock salt, clay, sulfur, or calcite

Used considerably in making of Portland cement to retard setting, used similarly in plaster, also used in insulation, stucco, wallboard, tile, lath, in the making of glass and pottery. *Satin spar* is fibrous and silky. *Gypsite* is an earthy gypsum deposited from salty lakes. Related *anhydrite* does not give off water when heated in a tube, is commonly used in furnace cements, phonograph records, and as building stone.



SERPENTINE

Antigorite, a Hydrous Magnesium Silicate

$Mg_3Si_2O_5(OH)_4$

Specific gravity: 2.5-2.65

Hardness: 2.5-5

Streak: White and glassy

Luster: Translucent to opaque

Cleavage: Orthopinacoidal

Fracture: Conchoidal to splintery

Fusibility: 5-6. Yields water when heated in a closed tube. Blowpipe flame fuses thin splinters at the edges.

Normally is affected by average flame. May be decomposed by hydrochloric acid or by sulfuric acid.

Crystallization: Usually fibrous, foliated or massive or granular.

Found in such rocks as peridotites, gabbros, and others commonly rich in magnesium often accompanied by dolomite, calcite, or magnesite.

Used in rocks as building stones or monuments; ground and used in fire-proof devices including clothing for fighting fires. *Asbestos* is a fibrous serpentine known as *chrysotile* used in making tiles, theater curtains, in electrical devices, to insulate heat pipes. Excellent nonconductor of heat, sound, and electricity.

TALC

$Mg_3Si_2O_5(OH)_2$

Specific gravity: 2.7

Hardness: 1

Streak: Usually but not always white

Luster: Pearly, at least on the cleavage edge

Fracture: Similar to cleavage

Fusibility: 5. Exfoliates with heat and fuses with difficulty; may yield water when heated intensely in a closed tube. If it fuses, it forms a white enamel. Heated with cobalt nitrate, it turns pale pink.

Is not easily decomposed by acids. Has a greasy feeling.

Crystallization: Orthorhombic or monoclinic or foliate or massive.

Found filling spaces between other minerals in such rocks as serpentine, schists, and dolomite or in large deposits.

Used in furnace lining, laundry tubs, sinks, switchboards, table tops, tank walls, in ground form in making of fireproofing, also in some cheap toilet powders, as filler for glazed papers, and for many other important things in modern civilization.

KAOLINITE

Kaolin, China Clay

$Al_2Si_2O_5(OH)_4$

Specific gravity: 2.6-2.63

Hardness: 2-2.5

Streak: White

Luster: Pearly, dull

Cleavage: Crystals, perfect, flexible, inelastic plates

Fracture: Earthy

Fusibility: Heated in closed tube yields water. Moistened with cobalt solution and heated develops a blue color.

Not soluble in acids

Crystallization: Monoclinic, usually compact noncrystalline mass

Found where rocks, particularly the feldspars, have decayed or in bed of some of the iron ores, particularly in Pennsylvania.

Used in the manufacture of china and porcelain and in the making of tile and bricks. If it is impure, especially if it has iron in it, it becomes brownish or red in the baking process. It is the basis of much of our clay.

The Plant Kingdom

DIVISION THALLOPHYTA

While some 85,000 species of plants belonging to the division Thallophyta have been described, comparatively few are well enough known to the average layman to have common names. True, the ordinary person has heard of toadstools, mushrooms, yeasts, molds, bacteria, seaweeds, and pondscums, but having heard about a plant and being able to recognize it when you see it are two different things. It is hoped that the small section of this book dealing with these plants will strengthen the understanding many persons have of this relatively small but highly important group of plants.

There are no smaller plants than the smallest of the thallophytes and no longer plants than the longest of them. From the smallest bacteria to the largest seaweeds, we have an infinite variety of representatives of the group. These plants have no stems, roots, leaves, or flowers though some of them have parts that provide an attachment as roots do, other parts that support as stems do, and expanded parts that function somewhat as leaves do. But these areas are not connected by such conductive tissues as we find in the so-called "higher" plants and these plants reproduce much more simply than most of the higher plants.

While in this book we recognize two subdivisions, the algae and the fungi, some botanists separate the bacteria from the fungi and place them in a separate group. These groups are elaborated as follows:

Subdivision I. Algae.	pp. 40-49
Subdivision II. Fungi	pp. 50-69

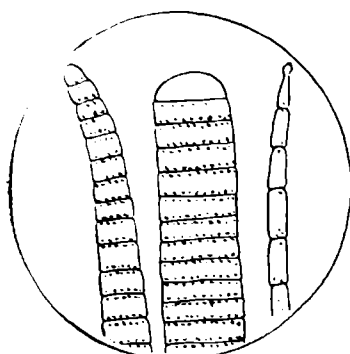
SUBDIVISION I. ALGAE

Some 14,000 species of algae have been described by scientists. Specialists in this field are known as algologists; while these workers rarely find their names on the front pages of the newspapers no modern community of human beings could exist successfully without putting some of their findings to use. Failure of a population generally to appreciate the role played by the algae in the scheme of nature may well lead to poverty of a nation.

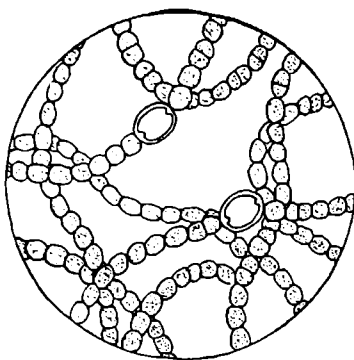
The algae provide the basis for the existence of practically all animals that live in the water. Without them, we could have no fish. With new discoveries of science showing new uses for many seaweeds, we may well exploit these resources as we have the forests of our drier environment and eventually find that with the disappearance of the seaweeds we will also lose our important marine animal resources. We must learn to manage these resources better than we have managed our land resources.

Algae help build land by anchoring silts. Some may be a serious source of pollution of our water supply while others serve effectively as aeration agents in the purification of our water supplies. Algae are component parts of the lichens that provide the basic food for Arctic animals (see p. 56) and are found in one form or another growing successfully in hot springs or on glaciers and in a variety of types of water. In this book we recognize four groups, as follows:

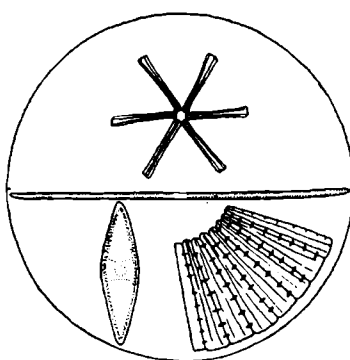
1. Cyanophyceae (Myxophyceae). Blue-green algae	p. 41
2. Chlorophyceae. Green algae	p. 41
3. Phaeophyceae. Brown algae	p. 43
4. Rhodophyceae. Red algae	p. 46



Oscillatoria



Nostoc



Diatoms

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE
CLASS CYANOPHYCEAE. BLUE-GREEN ALGAE
Order Hormogonales

Family Oscillatoriaceae

Oscillatoria

Oscillatoria sp.

Long, slender, unbranched filaments of cells commonly with long axis across the filament, usually blue-green, but some relatives are red. Found on moist banks and cliffs or in clear or putrid water. American genera, 11; species, 50. Related species give redness to Red Sea. Blue-green color due to chlorophyll, carotin, xanthophyll, and phycocyanin, not in definite bearers. Considered an index of contamination in water, either by self or by associated organisms.

Family Nostocaceae

Nostoc

Nostoc sp.

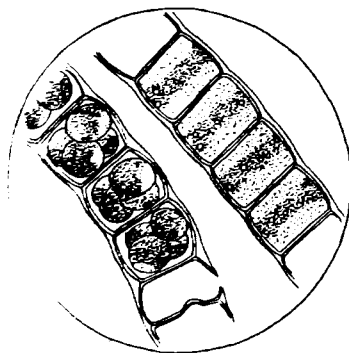
Under microscope appears like necklace of round cells embedded in gobs of jelly. Some species cause slipperiness of underwater rocks; others float to water surface or cling to rocks or wet earth. One species survives 3 ft. underground; another, in a lake at 60-ft. depth. American genera, 6; species, 22. Some colonies may be 2 ft. or more across but most appear as floating jelly masses that appear to be muddy. May provide some index of pollution.

CLASS BACILLARIEAE
Order Pennales

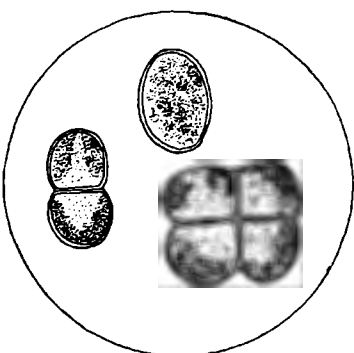
Family Diatomaceae

Diatoms

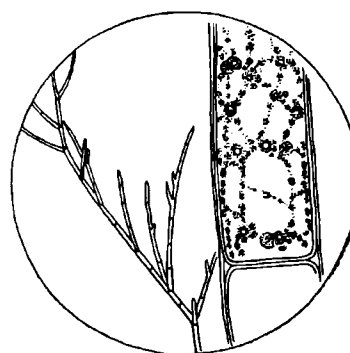
Commonly appears as jelly-like, slippery strings or masses clinging to underwater supports in fresh water. Essentially, masses of glass boxes enclosing plants reproduce by dividing and growing new valves to old. May remain dormant for years (48 years recorded). Forms with bilaterally symmetric valves, in order Pennales; with circular or irregular valves, in order Centrales. Excellent silt anchors, source of food for fish, and basis of diatomaceous earth (see page 23).



Ulothrix



Protococcus



Cladophora

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE
CLASS CHLOROPHYCEAE. GREEN ALGAE
Order Ulotrichales

Family Ulotrichaceae

Ulothrix

Ulothrix sp.

Commonly unbranched strings of green cells unlike most other genera that branch. Filaments break into new strings, may produce 4 swimming bodies per cell. United States genera, 7. Some species favor cold water, some warm; some running water, some quiet. Temperature has little effect on reproduction. Female cells swarm about a day; males, nearer a week when temperature is below 50°F. Most typical order of the Chlorophyceae. Most species are attached at some point.

Family Protococcalaceae

Protococcus

Protococcus sp.

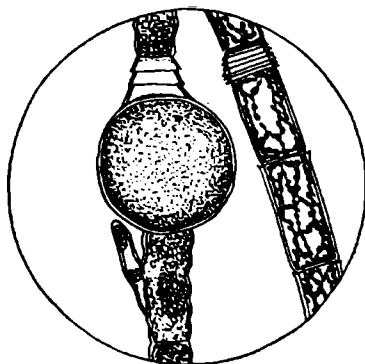
Simple green cells that divide into 2 and then into 4. Probably commonest alga in the world and is world-wide in distribution. About 5 species. Found in air, on trees, or rocks, in soil, on wet woods, in lichens, and elsewhere. Affected by humid winds, making tree bark greenest on side toward damp winds, not necessarily toward the North. Basis of food for lichens that are basis of food for reindeer and other animals that are basis of food for human beings (see lichens, pp. 56-57).

Family Cladophoraceae

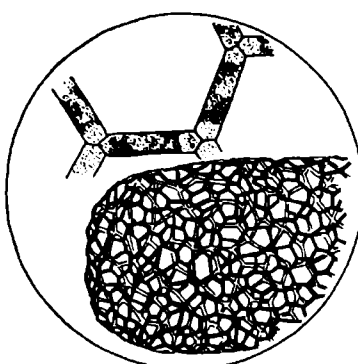
Cladophora

Cladophora sp.

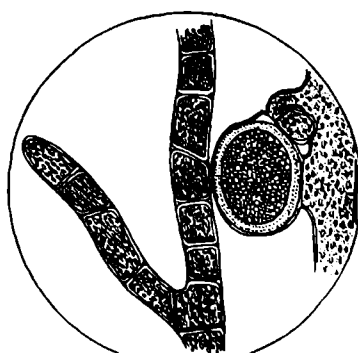
Branched strings of cells, with length of each cell rarely over 8 times its breadth. Reproduces by division, by nonsexual and by sexual spores, rarely forming large balls. United States genera, branched alga, 2; unbranched, 2. World-wide, found in fresh, salt, or brackish water, sometimes 150 ft. below water surface. Common in freshwaterways, supplying there some aeration and much basic food for valuable aquatic animals. May, on occasion, contribute to water pollution when too abundant.



Oedogonium



Hydrodictyon



Vaucheria

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE. CLASS CHLOROPHYCEAE

GREEN ALGAE

Order Oedogoniales
Family Oedogoniaceae

Oedogonium
Oedogonium sp.

String of barrel-like cells with small, green color bearers. Reproduce by breaking, by asexual spores, by single cell acting as egg with many swimming males, or by males producing small plants that yield sperms. United States genera, 3; species, 236; this genus unbranched and thus unlike others. Attached or free-floating in still or flowing water. Fruits May to July in North, after which strings may break. Plants commonly covered with lime.

Order Chlorococcales
Family Hydrodictyonaceae

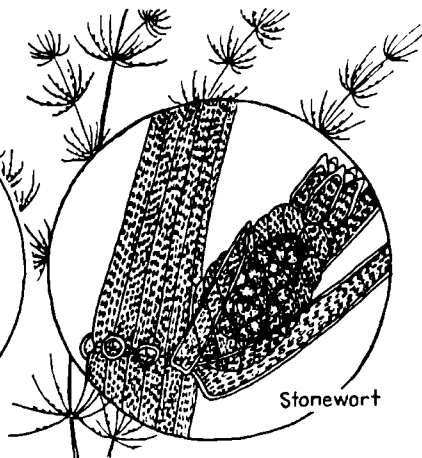
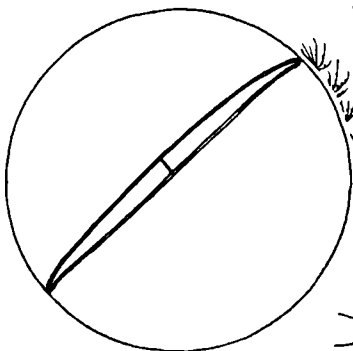
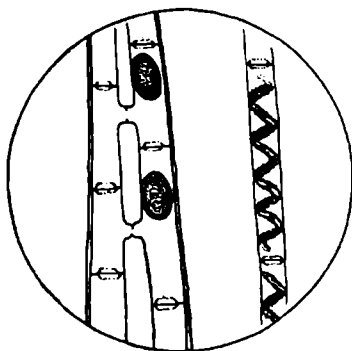
Water Net
Hydrodictyon sp.

Small, fine, green nets easily recognized by naked eye. Reproduce by breaking of nets or by small complete nets formed in individual cells by spores swarming just after daybreak. United States genera, in family, 4; species, 2. Found in still, permanent ponds of fresh water over most of United States. When undisturbed, nets over 1 ft. long may develop. Number of cells in a net once formed remains essentially the same with new nets formed by breaking of old. Each net of about 100 cells.

Order Siphonales
Family Vaucheriaceae

Vaucheria
Vaucheria sp.

Dense or weak mats of light yellow-green, slimy, branched filaments, without cross walls, attached or floating. Reproduce by breaking, by swimming spores, or by large eggs fertilized by sperms from bent male sex organ. Of 7 known groups of the genus, 4 are found in United States with specific differences based largely on nature of male sex organ. Swimming spores may be easily induced to form by bringing land forms into water, aquatic forms into darkness, or running-water forms into quiet water.



Stonewort

Order Zygnematales

Family Zygnemataceae

Pondscum
Spirogyra sp.

Unbranched strings, usually bright green and somewhat slimy or slippery, often enclosing gas bubbles in the floating or attached masses. Each cell with a spring-shaped coiled green body. United States genera, 9; species, 65. One of the commonest of the green algae in fresh water. Reproduce by breaking of strings, by joining of adjacent cells or of cells in adjacent strings, induced by changing ratio of surface and volume of water, temperature, or light. A pollutant.

Family Desmidiaceae

Desmids
Clostridium sp. et al.

Microscopic, of almost all imaginable shapes but all with cells with vertical pores through walls. *Clostridium* (shown) is one of 65 species found in hard waters. Some 21 United States genera commonly found free-floating in lakes and streams where hydrogen-ion content is between 5 and 6. Of the genera, 13 are solitary cell types. Reproduces by dividing or sexually by union of adjacent cells, producing a cell that resists unfavorable conditions and divides to make new individuals.

Order Charales

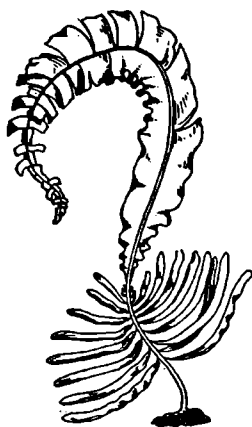
Family Characeae

Chara, Stonewort
Chara sp.

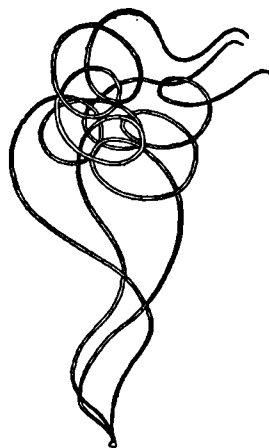
Branched, with branches of 2 kinds, one being somewhat needle-like and arranged in whorls and the other providing axes for the divisions. Brash, commonly lime-covered, with "fruits" borne in axils of shorter branches. Relatively common in springs and ponds with high lime content widely distributed. *Nitella* is more slender and fragile than *Chara* and without cell-covered internodes. Presence in water apparently limits development of mosquito larvae. Classification controversial.



Sea Lettuce



Henware



Devils Shoe-Lace

DIVISION I. THALLOPHYTES. SUBDIVISION I. ALGAE
CLASS CHLOROPHYCEAE GREEN ALGAE
Order Ulvales
Family Ulvaceae

Sea Lettuce

Ulva lactuca

Length to over 2 ft. Width to over 6 in. Broad, thin, with lobed, folded edges thickest at base. Attached with inconspicuous holdfast. Bright green. Highly variable in shape, with related *U. latissima* appearing as floating pale green sheets to 10 ft. long and nearly as broad.

Related *Monostroma*, of single cell layer; with *Ulva*, a double layer; and *Enteromorpha*, with layers separated to make a hollow. *Ulva*, on exposed rocks or wood, from Gulf of California to Alaska and from Gulf of Mexico to James Bay. Pacific Coast species, 13.

Some reproduction by fragmentation. Asexual reproduction through freeing of 4 to 8 swimming spores from a cell. Sexual reproduction by union of 2 similar swimming cells, 8 of which come from a single cell. United cells germinate into irregularly thread-like plants. Sporophyte stage differs from smaller celled gametophyte stage.

Ulva chiefly marine but may be found in brackish water. Related *Enteromorpha* grows well on bottoms of river boats that alternate between fresh water and salt water. Some of the family grow in brine lakes where salinity is much higher than in the ocean. *Ulva* survives considerable temperature range.

Ulva may foul shores causing bad odor after storm. May be boiled and seasoned and eaten as green laver or green slack though its use as food is vastly inferior to other algae here discussed. Apparently the commercial possibilities of sea lettuces have not been studied exhaustively.

Henware

Alaria esculentum

Blade broad, leathery, to 10 ft. long and 10 in. wide, with small, lateral, wing-like leaflets below the broad, terminal blade, the leaflets being without midribs; commonly with wavy margins torn and broken to midrib. Stem compressed, to 1 ft. long, $\frac{1}{2}$ in. wide. Holdfast branched and rather elaborate.

Differs from *Laminaria* in possession of midrib in blade. Essentially northern. Commonest on exposed rocky coasts below tide levels. From Long Island north to Hudson Bay and Newfoundland. Nine Pacific Coast species from California to Alaska.

Perennial, but each year blade is replaced by new growth. Ordinary plant seen is sporophyte or spore-producing, the sexual plants being microscopic and bearing either male or female sex organs with the female filaments being the simpler and usually bearing one terminal egg that develops into the sporophyte when fertilized.

Named *Alaria* from the Latin "ala" meaning wing and referring to the wing-like leaflets below the blade. The sporophylls that bear the spores taking part in asexual reproduction are shed annually. Sporangia are borne on the margins of the sporophylls. Sexual plants do not resemble each other closely.

Yields the food known as "kombu" from the northernmost Japanese Islands where it is used with meats and sauces or poured over rice or used as tea. Is eaten in Iceland, in Scotland, and in Ireland. Known as "henware," "murlins," "badderlocks," and "daberlocks" in these areas.

Devil's Shoe-lace

Chorda filum

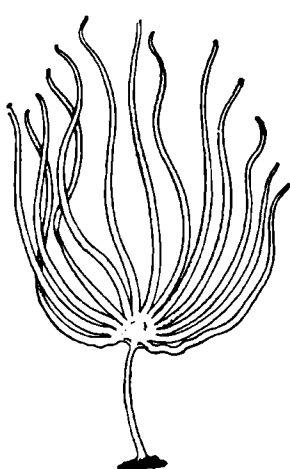
Fronds rope-like, slender, less than 1 in. in diameter but frequently over 12 ft. long and reported to 40 ft. When young, the surface is coated with delicate colorless hairs, but when mature the tips are commonly partly decayed. Whole mass of these plants looks like a writhing collection of snakes. Brown, with air cavity in middle.

Common on stones and shells below tide level, held rather erect by internal air cavity. May reach water surface and there rot. Ranges from New Jersey to Baffin Bay, through the arctic regions and into Hudson Bay and Baffin Bay.

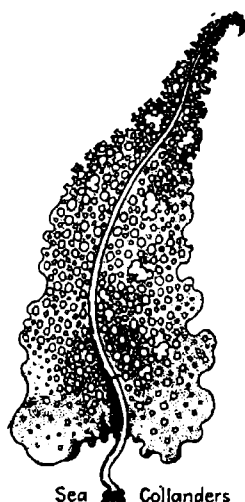
Asexual spores are borne in special structures somewhat cone-like in shape on the surface of the blade. From these spores, produced in late summer and autumn, arise the conspicuous annual plants we see. Sexual reproduction is effected through microscopic structures not easily seen.

Apparently, from the distribution notes, this plant does not favor the warmer seas as do so many of the marine algae but in masses it does lend character to northern marine gardens not duplicated in southern areas. It is reported as growing in beds in the North Sea and British Channel 20 miles long and under 600 ft. wide.

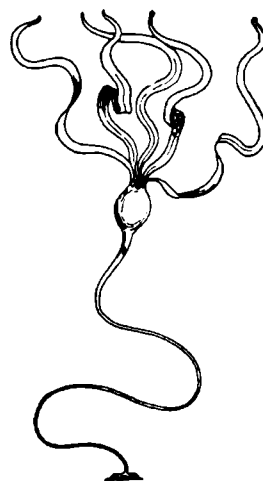
The plants adhere to mounting paper when they are made into herbarium specimens. Old fronds should be allowed to dry before mounting, but the young ones may be floated onto the paper, to which they will eventually fasten themselves if dried under pressure.



Fan Kelp



Sea Collanders



Ribbon Kelp

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE. CLASS PHAEOPHYCEAE
Order Laminariales. Family Laminariaceae

Fan Kelp

Laminaria digitata

Blade of to 30 or more finger-like segments each to 3-4 ft. long and growing from a common point or expanded area at the end of a stout stalk that is to 5 ft. long, flattened above and in section showing concentric growth rings but no mucilage ducts. Holdfast fibrous.

At least 10 species on Pacific Coast of United States with *L. sinclairii* found from Vancouver Island to Obispo County, Calif. *L. digitata* ranges from Staten Island to Hudson Bay, Nova Scotia, and New Brunswick most commonly on exposed rocky bottom below low-tide levels.

Perennial. Asexual zoospores and sexual gametes are essentially alike. For some time, it was not believed that sexual reproduction took place in *Laminaria* but it is now well established. The male and female sex cells are essentially alike.

Named from Latin "lamina" meaning leaf or blade. Yields phycocolloid laminarin, a reserve carbohydrate; and fucoidin, a water-soluble carbohydrate of no recognized commercial value. Rich in iodine that constitutes 0.049% of whole plant; also considered high in certain vitamins and minerals.

In 1941, 4 United States concerns made 1½ million dollars' worth of algin from *Laminaria* and *Macrocystis*. Japanese who eat it are free of goiter. Dried known as "kombu"; shredded and dyed green, as "ao"; crisped over fire, as "hoira kimbu," with sugar icing as "kwashi." Tons harvested in Japan and Russia for fertilizer.

Sea Collanders

Agarum cribrosum

Blade to over 9 ft. long and 1 ft. wide, abundantly perforated, heart-shaped at base when mature and with a median midrib to 1½ in. wide at the base. Stalk stout, cylindrical, to 2 in. long and ½ in. through. Blade unrolls from 2 cone-like scrolls and looks tattered. Holdfast slender, spreading.

Appears in closely related forms on Atlantic and Pacific Coasts. This species from Bering Sea to San Juan Island, Wash., with the related *A. fimbriatum* from Puget Sound to San Pedro. *A. cribrosum*, from Massachusetts to Ellesmere Island.

Fruiting areas are irregular in shape, irregularly placed, and appear darker and thicker than the regular vegetative tissues, usually more abundant near the midrib. Spore cases usually elliptical in outline. Forms found growing in shallow water or tide pools are dwarfed in comparison with deep-water plants.

The common name collander probably refers to the fact that the blade resembles the kitchen colander in its sieve-like appearance. Another common name, devil's apron, probably refers to the general apron shape of the whole blade. The genus *Agarum* refers to the Malayan word "agar-agar" or edible seaweed.

While the plant no doubt has many of the uses recognized for its close relatives, the literature does not often list it as a commercially valuable plant. It should be assumed from its generic name that it is edible and that it may be important as a source of agar-agar.

Ribbon Kelp

Nereocystis lutea

Length probably not over 150 ft., in spite of published reports of larger size. A single large globular float is developed at the end of the long flexible stem and at the base of the relatively few but long flat leaf blades. Stem shows outer layer of colored cells around a storage area that surrounds a central pith.

Found on our Pacific Coast and is definitely associated with rocky shoals and reefs, found in water from 10-100 ft. deep but at its best where there are strong currents or heavy wave action. Found from Aleutians to California.

Gamete-bearing cells are found in dense masses on certain parts of the plant. The freed gametes were formerly taken for zoospores or asexual spores but apparently they produce small plants that yield the regular sperms and eggs from which the huge plant develops after the egg is fertilized.

Nereocystis beds yield potash. Of the dry weight of the plant, about 25% is potassium chloride, which at the outbreak of World War I was worth \$40 a ton but which has since increased in value. The plants have some value as food for cattle, as well as being used for raw fertilizers.

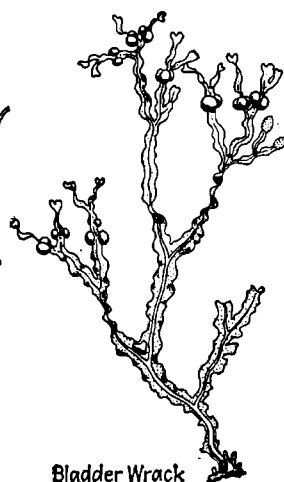
The common names include bladder kelp. The scientific name refers to Nereis, the daughter of the sea god, Neptune. So closely are the plants associated with rocky reefs that fishermen and sailors using shallow-draft boats recognize them as important navigation guides.



Giant Kelp



Rockweed



Bladder Wrack

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE. CLASS PHAEOPHYCEAE

Order Laminariales Family Laminariaceae

Giant or Vine Kelp *Macrocystis pyrifera*

Length reported to 1,500 ft., making it probably the longest plant in the world. Blades bear thin, wrinkled, olive leaflets, with egg-sized bladders at point of attachment. Stem rarely over $\frac{1}{4}$ in. in diameter. Leaves 2-4 ft. long, and 3-4 in. wide. Holdfast branched; about 1 bushel in size.

Grows in water 20-70 ft. deep, forming dense beds where conditions are right. Restricted to our Pacific Coast from Alaska to California and on to Asia and Kamchatka. Bladder-supported leaves may float at surface.

Named from the relatively large floats. Yields new plants in essentially the same manner as was described for *Laminaria*. Some areas may be well-populated by fragmentation of the huge plants with the floats supporting the fragments where they may continue growth.

Yields the phycocolloid algin, alginic acid and sodium alginate, ammonium alginate, calcium alginate and chromium alginate, also much potash and iodine. Of the whole plant, some 0.28% is iodine. Algin was first separated in 1883, using sodium carbonate for digestion of the plant material.

Harvested commercially in California. In 1941, $1\frac{1}{2}$ million dollar's worth of algin was produced by 4 United States concerns from *Macrocystis* and *Laminaria*, while a few years earlier none was produced on any extensive commercial basis.

Rockweed *Ascophyllum nodosum*

Length to nearly 10 ft. but usually much smaller. Erect, from a disc-shaped holdfast. Main stem and main branches flattened, with egg-shaped, air-filled bladders to over 1 in. long and $\frac{3}{8}$ as wide, with usually but one to a branch. With flattened, club-shaped branches to 1 in. long, solitary or grouped.

Commonly found growing with *Fucus* on rocky coasts or on rocks emerging from muddy bottoms below the tide levels. Ranges from New Jersey to Newfoundland and Baffin Island, Labrador and Cumberland Sound. Also in Bermuda.

In reproduction, the branchlets change into, or are replaced by, the sexual reproductive tissues that are either male or female. They are yellowish, drop from the main plant in spring following the winter's fruiting, and are replaced by new branchlets. The eggs and sperms are different in size and 4 eggs are in each egg sac.

In quiet water, these plants are more slender than in rough water. They occur in salt marshes and in brackish water entangled with other plants or poorly attached to shells and other such objects. The plants appear to be made of cartilage. The broken or shed fruiting branches often are found in great numbers.

Of little or no economic importance, though it is possible that they have some small value as a fertilizer. The plant turns black on drying, has larger air chambers than *Fucus*, and is in general tougher than *Fucus*, as might be indicated by its larger size.

Order Fucales Family Fucaceae

Bladder Wrack *Fucus vesiculosus*

Length of sprays to 2 ft., with distinct midrib through all the branches, rather regularly forked, flattened, olive green, with swollen bladder-like structures filled with gelatin. Fronds tough, flexible, leathery. Holdfasts branching, root-like, leathery, with sucker-like ends.

One of the world's most widely distributed groups, being found in the arctic and temperate oceans of the world, but this species not found abundantly south of New York on our Atlantic Coast though it appears from North Carolina to Newfoundland and Baffin Bay.

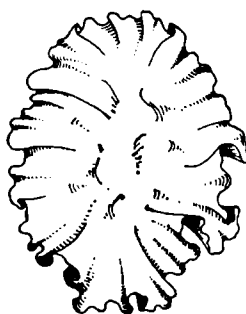
Apparently there are no asexual spores produced. Sexual reproduction results from union of sperms and eggs produced on different plants from autumn to spring in the southern part of the range. Male receptacles are reddish when opened while the females are olive green, but both are near branching tips.

Yields the phycocolloid fucoidin, a polysaccharide first extracted by Kylin from *Fucus* and *Laminaria* in 1913. Like laminarin, it as yet has no well-established commercial value. It probably occurs in nature as a calcium salt and, on hydrolysis, gives rise to fucose. Because of mucilage, plants do not dry quickly.

Plants are collected by seashore farmers and spread on the ground as fertilizer. Have some value as a source of iodine and at one time were an important source of commercial potash. A medicine used in treating obesity has been taken from *Fucus*, and it has been used to some extent in making cosmetics.



Gulfweed



Laver



Tengusa

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE
CLASS PHAEOPHYCEAE CLASS RHODOPHYCEAE. RED ALGAE

Order Fucales

Family Fucaeeae

Gulfweed

Sargassum filipendula

Length to nearly 1 yd. Erect, with main stems smooth, sparingly forked, and bearing alternate stalked leaves that are to 3-4 in. long and $\frac{1}{8}$ in. wide, thin and sometimes forked but usually with saw-toothed edges. Stems also bear spurs ending in bladders that are to $\frac{1}{8}$ in. in diameter. Holdfast conical, spreading, lobed.

This species grows attached to shells and stones in relatively quiet water from low-tide level to 100 ft. deep. There are some 150 species of *Sargassum* in the world, mostly about Australia and Japan, with 17 in Pacific United States. This species, Florida to Nantucket.

Probably perennial, bearing fruit at maturity that arise from union of different-sized sex cells with but one egg to an egg cell. Fruiting bodies are cylindrical and more or less forked. *S. fluitans* and *S. natans* of our Atlantic seas reproduce only by fragmentation, no fruiting bodies being known.

Name comes from the Spanish "sargazo" meaning floating seaweed. The Atlantic Sargasso Sea, long famous as a dead spot in days of sailing, which lies between lat. 25-31°N. and long. 40-70°W., is not composed primarily of sargassum. Yields the phycocolloid algin, alginic acid, and alginates of sodium, ammonia, calcium, and chromium.

Japanese fishermen eat the tender tips of the floating plants of their region. Because of relatively small size of this species, it is not likely to be of great commercial value compared with other algin producers such as *Laminaria* and *Macrocystis* and similar plants.

Laver

Porphyra umbilicalis

When young, narrow; but when mature, like a broad, somewhat elastic membrane, fragile, often only one cell in thickness, purple to olive to brownish-purple but always with a smooth, satiny sheen. Attached by a small obscure holdfast at the center. Edges frilled or wavy in appearance. Whole plant appears slippery.

On rocks or piling from the low-tide to mid-tide lines. This species from New Jersey to Hudson Bay and Newfoundland; closely related forms are in both hemispheres from Polar seas to Mediterranean, Australia, Tasmania, Cape Horn, and Cape of Good Hope.

Reproduction: asexually, by means of spores freed to swim from rather large continuous areas of the blade; sexually, by spores freed from plants that may be either male or female or both; in the latter case, male and female portions are generally separated, with the males coming from a marginal band and the females from over the surface.

An annual plant that may be found at almost any time of the year. The name is derived from a word meaning purple dye. The pressed plant does not adhere to paper when dry. Used in England as food as "laver"; in Ireland as "slack"; in Hawaii, as "limu"; and in Japan as "amanori," or "amori." Boiled and eaten with lemon juice, spice, or butter.

Chinese grocers in Hawaii have imported in a year 70,000 lb. of laver worth about \$12,000. Japanese cultivate nearly 1,000 acres by thrusting in bamboo bundles on which algae grow to be harvested in 3-4 months. In 1901, such plantations yielded \$156 an acre but 40 years later they yielded as much as \$300 an acre.

Tengusa

Gelidium corneum

Frond flat and horny, to 4 in. high, narrow, erect, branching, in one plane being 2-3 times pinnate and with sections composed of somewhat compressed cylinders. Very variable in shape, size, and color, being red to reddish-brown to purplish-red and when exposed becoming a dirty white. Tip of branchlets club-shaped.

The Atlantic Coast species is *G. crinale* that reaches a height of 3 in., while the West Coast *G. corneum* is 1 in. higher. Grows in tufts on mud-covered rocks and on other algae. Most abundant on West Coast from California to Lower California, Mexico.

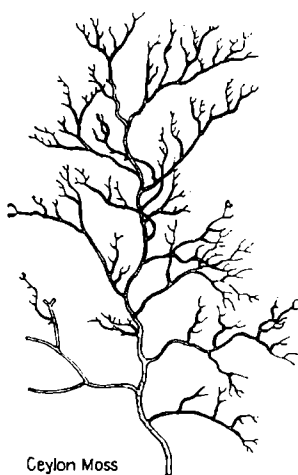
Asexual spore cases are found in the surface of rather special areas or on special branches. Sexual plants are like those bearing asexual spores in general, with the male elements produced from the surface of considerable areas and the female borne on inner tissues and spread through the general nutritive tissue.

Yields agar (gelose), a phycocolloid, agarinic acid, and the salts sodium agarinate, potassium agarinate, calcium agarinate, and magnesium agarinate. In Japan the species of most importance has been *G. amansii*. *Gelidium* agar in 1% water solution sets at 35-50°C. to form firm gel and melts at 80-100°C.

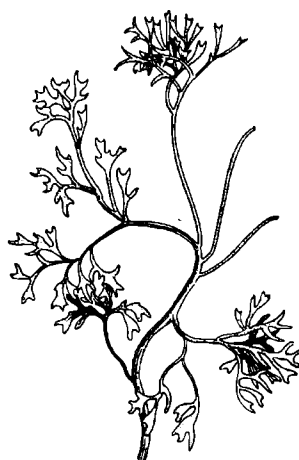
Probably the most important of all the agarophytes as source of agar necessary for bacteriological work, as medicine to relieve constipation, as food in form of jellies, soups, sauces, and desserts. Gives rigidity to soft canned fish, improving marketability after shipping. Known as "kauten" and "Oriental isinglass."



Common Coralline



Ceylon Moss



Phyllophora

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE. CLASS RHODOPHYCEAE

Order Cryptonemiales

Family Corallinaceae

Common Coralline

Corallina officinalis

Like slender, rigid, jointed, bushy, lime-encrusted, easily broken coral, to about 3 in. in height. The joints are cylindrical but flattened above and wedge-shaped. Color varies from reddish-purple to gray-green to almost chalky white. There is some flexibility at the joints. Branches are at least 3 times branched.

Common on Atlantic Coast, particularly from New York north to Newfoundland, growing mostly on rocks in fairly deep water up to area between tides. Also found in tidal pools. Likely to be more matted in rougher waters.

In members of this family the reproductive organs are sunken in the crust of the plant or on enlarged terminal branches; in this species they are hornless, except in those bearing the male sex organs. There is a small pore at the end of the sex-bearing regions.

Found throughout the year, but so variable that many have suggested different species names for the forms that different environments have developed. These plants are not mucilage-covered and therefore do not adhere to mounting paper when made into herbarium specimens.

Probably of little direct economic importance to man. It is believed that the corallines growing frequently on coral reefs add to the limes of such reefs and so help them grow.

Family Gracilariaceae

Ceylon Moss

Gracilaria confervoides

Frond bushy, arising from a disc-like holdfast that frequently breaks, freeing the whole plant. Branches to 0.1 in. in diameter, dividing repeatedly and variously but not so conspicuously evenly as in some close relatives. Firm, fleshy, and tapering to fine tips at the free ends. Dull purple-red to purple to green.

This species in shallow, warm, quiet bays attached on loose materials near bottom, from the tropics and Florida to Prince Edward Island. *G. multipartita* or *G. foliifera* is much branched and found on both coasts. Other relatives in Africa, Australia, Britain.

Asexual spores borne in structures scattered over the branchlets, these structures being oval in shape and developed definitely from surface cells. Male element also produced from surface cells. Female element borne on structures on special branches but after fertilization these develop into conspicuous numerous hemispheres.

In the New England area, the plant is crisply bushy. Yields gracilaria agar, agarinic acid, and the salts sodium agarinate, potassium agarinate, calcium agarinate, and magnesium agarinate. *Gracilaria* was the original source of commercial agar, whose uses have been discussed elsewhere in this section.

Gracilaria is the chief commercial source of agar produced in the vicinity of Beaufort, N.C., and no doubt figures in commercial activities elsewhere. It is used in bacteriological work, in dental impressions, in health foods, and in baking. In 1940, one United States agar factory produced 24,000 lb.; in 1945, 4 produced 200,000 lb.

Family Phyllophoraceae

Phyllophora

Phyllophora membranifolia

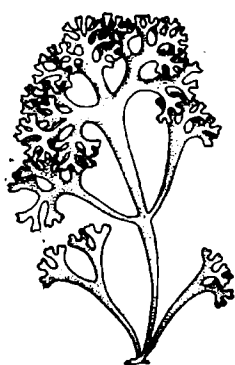
Fronds to 20 in. long but usually shorter, with short, stubby, wedge-shaped, forked, or cleft branches each under 1 in. long. Several fronds, sometimes as many as 20, arise from a single disc-shaped holdfast. Like a firm membrane that is dull purple or clear red but with some brighter areas.

Found commonly growing on stones in shallow tidal pools or in water several feet deep but mostly in warmer waters. This species ranges from New Jersey to New Brunswick, Prince Edward Island, and Cumberland Sound.

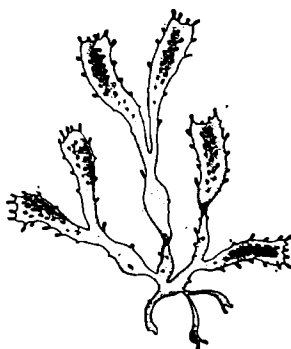
Asexual spores produced in rather large, slightly raised spots near the bases of the blades with surrounding cells obviously radiating. Male element produced on small, brightly colored blades and attached to the edges of these blades. Female element borne in stalked structures usually attached to stem.

A perennial plant. Found throughout the year but commonly fruiting in autumn and winter. Yields an agaroid that is possibly a kind of agar though it apparently has not been studied exhaustively or put into much commercial use in the United States. At least three species represented on our Atlantic Coast.

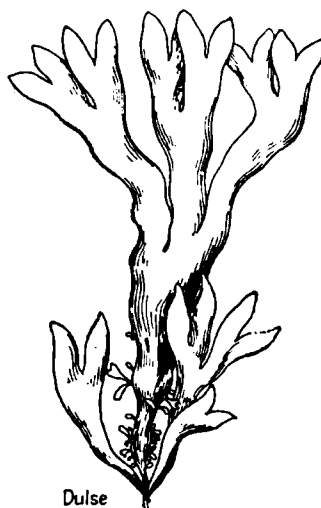
From Odessa and the Black Sea, it is reported that a species close to ours yields a kind of agar, but as to any further commercial use we have not been informed.



Irish Moss



Batters



Dulse

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE.

Order Gigartinales Family Gigartineae

Irish Moss, Carrageen

Chondrus crispus

Fronds to about 6 in. high, arising in clumps from a disc-like holdfast, with flattened stems that divide and subdivide to form rather broad fans, there being 5-6 subdivisions and the divisions taking place when the stems are about $\frac{1}{8}$ - $\frac{1}{2}$ in. wide. Stems thick, rough, leathery, olive to dark purple to jet black.

Most abundant on our Atlantic Coast from Maine to Carolina but also common on to Newfoundland, growing throughout the year on wood, shells, and rocks from mid-tide line to considerable depth. Does well in highly varied environments.

Asexual spores produced in obvious cases formed below the surface of the tissue. Male elements borne in conspicuous cases on the surface of young branches with the female elements borne on other branches from the inner surface, with the fruiting bodies to 0.1 in. across and swollen laterally.

Fruiting occurs during the summer with the asexual activity more common in late autumn. Color varies from pale in shallow pools to purple in deep pools to iridescent in the sun. Named from Greek word for cartilage. Extracted carrageen in 3% water solution gels at 27-30°C.; and in 5% solution, at 40-41°C. Ash, 20%.

Of the water-free matter, 65% is gelatin. Used in making gloss soaps, jellies, puddings, cosmetics, shaving soap, shoe polish, blanc mange pudding; for curing leather and sizing cloth. Industry centers at Scituate, Mass. Yields phycocolloid, carrageenin. In 1944, industry in United States yielded about \$500,000.

Batters

Gigartina stellata

Fronds from 6 in. high to 2 in. broad, in thin, flat, gelatinous, leathery, wavy, wedge-shaped divisions that fork at the base only to subdivide again in the same plane at a higher level. Unlike Irish moss, has tufted protuberances on the concave side of the fronds. Dark purple to black and rigid when dried.

Common in the tropics and from Massachusetts north to Nova Scotia and Newfoundland, growing with Spanish moss in shallow tide pools, on exposed rocky shores but always near low-water mark. Found at any time of the year.

Perennial. Asexual spores borne from immersed, irregular cases of the inner surface. Male elements appear from cases in terminal, closely branched stems and from surface cells. Female elements borne in special crowded clumps or branches, and from areas under the surface. When fertilized, develop into fleshy units.

Fruiting takes place in winter. Dried plants do not adhere to mounting paper. Yields the phycocolloid carrageenin and carrageenic acid and the salts potassium carrageenate and calcium carrageenate; together with Irish moss, is the principal source of these materials. Known as the polysaccharide, carrageenic extract.

Carrageenin from *Gigartina* and *Chondrus* has a higher ash content (20%) than agar and requires 3% rather than 1% concentration in water to gel. It gels at a lower temperature than agar. In 1944, 3 United States firms produced \$500,000 worth of carrageenin in a standardized form.

CLASS RHODOPHYCEAE

Order Rhodymeniales Family Rhodymeniaceae

Dulse

Rhodymenia palmata

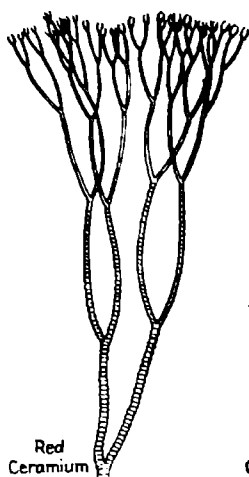
Fronds to nearly 2 ft. long, with an inconspicuous stalk arising from a small disc-like holdfast and bearing blades that break into two or more divisions with the forks to 6 in. wide but usually narrower. Like leathery membranes that are purple or red in color. Frequently shows numerous smaller fronds near base.

Found from the mid-tide zone to deep water but in the southern part of the range restricted to the deeper water. This species ranges from New Jersey to Baffin Bay and Ellesmere Island and in Europe is found south to the Mediterranean.

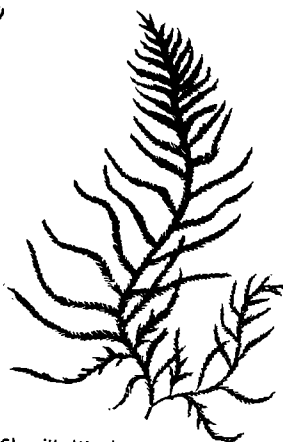
Asexual spores are produced in scattered cases that appear as darker spots on the blade and are also indicated by a thickening of the outer layer. These structures appear in the winter season. In this species, no true sexual reproduction seems to have been discovered. Related species have sexual reproduction that results in a swollen fruit with a loose case.

When dried, this plant has a faint odor of violets. It is eaten in widely separated parts of the world. Icelanders dry it, make a flour of it, eat it raw, or boil it in milk. Scots use it for chewing tobacco, as a relish, for medicine, or boiled in milk as food. Irish know it as "dillesk," boil it in milk, chew it, and eat it with fish.

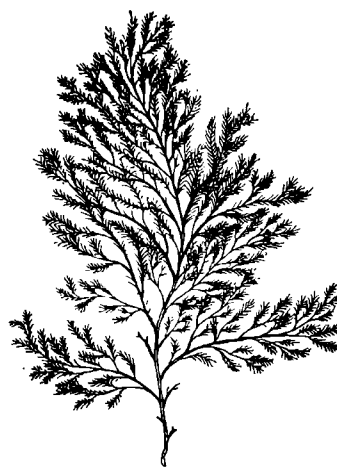
In time of famine in Ireland, dulse and potatoes formed a diet that saved this important part of the world's population. In Norway, it is known as sheep's-weed because sheep are extremely fond of it and seek it at low tide when it is exposed.



Red
Ceramium



Chenille Weed



Polysiphonia

DIVISION I. THALLOPHYTA. SUBDIVISION I. ALGAE. CLASS RHODOPHYCEAE

Order Ceramiales

Family Ceramiaceae

Red Ceramium *Ceramium rubrum*

Fronds like large, leafless, bushy structures rising to over 1 ft. in height, forking and reforking with the ends finally claw-like and incurving, with a "bark" of small cells forming rings at joints and making obscure bands, obviously lime-encrusted and the whole bush arising from a basal disc. Deep red, with some variation.

Common in almost all seas of the globe, growing on rocks, on plants, on wood, and on shells from between the tidal levels to moderately deep water. Found throughout the year. This species is found from the tropics and Florida to Newfoundland.

Asexual spores are produced from 1-3 rows of cells around the joints or scattered and indicated by a slight swelling. Male elements produced from crowded tufts on the surfaces of the younger, more slender branchlets. Female elements borne on lateral branchlets that become protected by 3-5 incurving branches.

Fruiting on this species takes place in the summer months. Many varieties or even species have been suggested but these are joined by such closely integrated series that it is doubtful if they are valid. Differences recognized include variation in branching, in region where fruits are borne, in stoutness, and even in color.

It is doubtful if this alga is of any great economic importance to man. It is believed that because of its incrustation of lime it may be of assistance to corals in the development of coral reefs.

Family Dasyaceae

Chenille Weed *Dasya pedicellata*

Fronds to 10 ft. long, with the cylindrical stem covered with fine hairs that give the whole plant a velvety appearance. Stems long and sinuous rather than bushy, with branches sparingly divided. Color brilliant red or pink but when taken out of water, appears like strings of purple jelly in masses.

Found just below the low-tide mark, usually in protected waters where the tide flows. This species ranges from Florida to Nantucket and extends on south into the tropics. It is rather abundant in the New York Bay area.

Fruits from midsummer to autumn. Individual plants produce either asexual spores or the male element or the female element. Asexual spores are borne in distinctive curved structures. Male cells are slender, pointed, and usually filament-tipped. Egg-bearing units are usually stalked and 0.1 in. through.

The plant sticks to paper well when mounted as an herbarium specimen, but because of its delicate nature should be subjected only to light pressure. It is considered a good late autumn alga and in the Woods Hole area is obvious as late as October. *Dasya* means hairy and the name is appropriate for this plant.

Apparently there is no obvious economic value to be attached to this plant unless one recognizes its beauty; it certainly adds to what might otherwise be an uninteresting bit of environment. It is probably good food for some marine animals and provides them with some shelter from their enemies.

Family Rhodomeliaceae

Polysiphonia *Polysiphonia fibrillosa*

Fronds to 10 in. or slightly longer, appearing like pinkish or reddish slippery "worms" hanging attached to exposed rocks at low tide or erect or weakly floating in shallow water. Profusely and irregularly branched, coarse at the base but fine at the tips. Light or dark brownish-red to black.

Over 100 species found both on our Atlantic and our Pacific coasts, most commonly seen on stones and vegetation in shallow water but may be found in deep water as well. Not an abundant alga and in some New England areas is rare. New Jersey to New Brunswick.

Asexual reproduction, through spores borne on somewhat spirally distorted branchlets. Male elements borne in spindle-shaped structures at the ends of the branchlets. Female elements borne in short-stalked egg-shaped or spherical structures and forming a relatively large fruiting structure. Fruits in summer.

This is a summer annual that favors or rather does best in warm bays. The genus is represented by many species, of which approximately a dozen are found along our Atlantic Coast, in which the rather obvious differences are based on type of branching, stoutness, and types of fruiting areas.

Apparently little economic importance can be attached to this rather beautiful red alga. It merely helps make a tidal area look as we think such a region should. When mounted on paper, the plant appears to be surrounded by a peculiar "mist," owing probably to fine hair-like coverings not noticeable otherwise.

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI

Over 70,000 species of plants have been described by scientists as belonging to the fungi. No animal could exist without these plants; some of them are familiar to the ordinary layman but many more are relatively unknown though they are with us from birth to death and may even cause death.

The fungi lack the chlorophyll or green coloring matter so common in most other plants and are therefore unable to make carbohydrate food with the assistance of sunlight. This makes it essential that they get this food from other organisms, either directly or indirectly. Fungi vary greatly in the method and vigor with which they depend on other organisms. Some of them are parasitic, taking what they need from living things; some are saprophytic, taking what they require from dead organisms; still others are symbiotic, giving to, and taking from, the organisms with which they are intimately associated.

In this book we have chosen to recognize that the fungi are divided into the following classes:

Class Schizomycetes. Bacteria.	p. 50
Class Myxomycetes. Slime molds	p. 51
Class Phycomycetes. Algal fungi, molds	p. 52
Class Ascomycetes. Yeasts, mildews, lichens	p. 52
Class Basidiomycetes. Rusts, smuts, mushrooms, puffballs	p. 58
Fungi Imperfecti.	p. 69

CLASS SCHIZOMYCETES. BACTERIA

Most persons regard these minute plants as essentially harmful and certainly too small to see. They may wonder why bacteria are included in a book on field natural history where presumably a compound microscope will not be available. We look across a valley and see masses of trees making a forest without being able to determine from a distance just what kinds of tree are in the forest. Similarly, we may see masses of scum on vinegar, strings of rusty gelatin lining water pipes at their outlet, or swellings on the roots of clover. These are either masses of bacteria or of their products or evidence that certain bacteria are in a given place. If we can make a census of mammals of a forest by observing the tracks without ever seeing a mammal, why can we not consider the evidence of the existence of bacteria in the outdoors? The field naturalist should have some recognition of the evidence of the existence of these plants, which are probably the smallest living things and which have lived on the earth probably longer than any other living things.

One philosophical bacteriologist has estimated that for every harmful bacterial organism to be found in the world there are approximately 50 others that are harmless or essentially helpful. To live happy, successful lives, we must learn how to use the helpful forms and to avoid those that are dangerous.

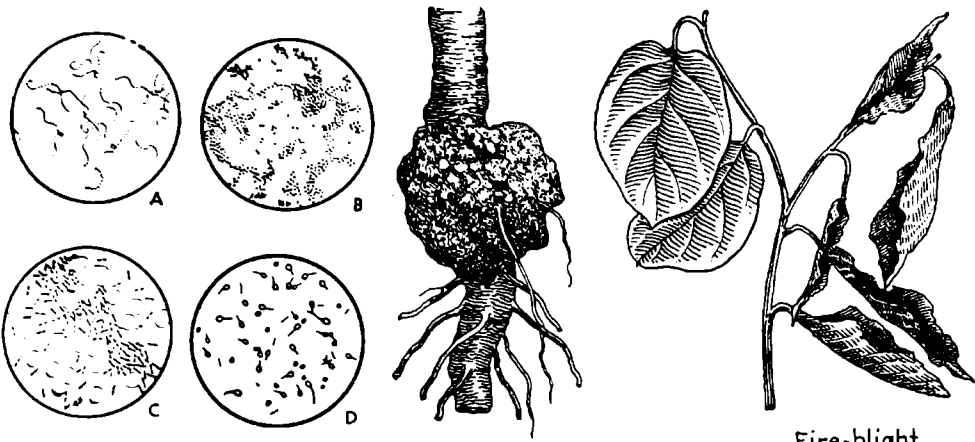
The term *microbe* cannot be used as a synonym for bacteria. Microbe includes not only the bacteria but the molds, the protozoa, and other microscopic plants or animals. Many of these microbes have a prodigious reproductive capacity. While a young pig may double its weight in a month, a young yeast (not bacteria) can double its weight in 2 hours. A yeast-fermenting tank can produce in a single day the protein equivalent of 8 pigs a day. It is quite possible that in the future we may be eating bacteria and yeasts instead of pork and beef and do so with less strain on ourselves and on other living things. Let us survey some of the important roles played by bacteria.

Bacteria and the Soil

An acre of rich farm soil might well support 3 woodchucks weighing about 30 lb. The same soil might well support 240 lb. of bacteria and an additional 240 lb. of fungi and microscopic animals. By far the greater proportion of the bacteria would be usefully engaged in changing the compounds of the soil. Some of these would be found in the roots of legumes (see pp. 224-238) and many might be engaged in fixing free nitrogen or taking part in the changes that make various foods available to plants and to animals. The same soil might also contain tetanus bacilli that, once transferred to our bodies, might cause lockjaw and death. Other bacteria in the soil might play a part in fixing or in freeing iron, sulfur, or phosphorus, all essential to living things.

Bacteria and the Air

Even the free open air may be the carrier of some kinds of bacteria. Sometimes these are relatively dry, but more often they are in small drops of liquid suspended in the air. Liquids from a person with tuberculosis may be discharged as sputum or in other ways. When these liquids dry, they may free *Mycrobacterium tuberculosis* into the air. If these reach a healthy person before they are themselves killed by high temperature or by sunlight, they may cause the disease in the healthy person. Similarly, *Streptococcus*, which causes streptococcic sore throat, or death, may be spread. Sunlight and heat and dryness are fatal to a majority of the dangerous bacteria found in the air and elsewhere.



Bacteria

Pseudomonas tumefaciens

Fire-blight
of Pear

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS SCHIZOMYCETES.

BACTERIA

Disease-causing Bacteria

- A. Cause of streptococcic throat
- B. Cause of pus
- C. Cause of pneumonia
- D. Cause of lockjaw

Crown Gall of Peach

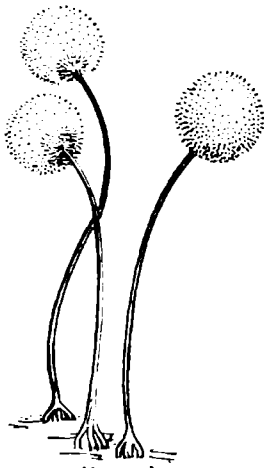
Pseudomonas tumefaciens

Found on peach, cherry, almond, apricot, plum, prune, chestnut, walnut, apple, tomato, potato, beet. Intercommunicable.

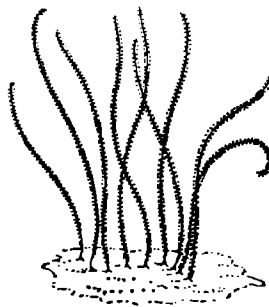
Fire Blight of Pear

Bacillus amylovorus

Worst on pear but also bad on apple, quince, hawthorn, plum, apricot, mountain ash, and other plants.



Cribraria



Stemonitis



Lycogala

CLASS MYXOMYCETES. SLIME MOLDS

These unique organisms, of which there are more than 300 species, have been classed as animals, the Mycetozoa or fungous animals, because in the plasmodium stage of their life history they may move like such simple animals as the amoeba. At this time they are essentially a naked slimy protoplasmic mass that moves about in wet environments. Eventually this dries into a concentrated mass that may form fruit bodies freeing spores like many other plants. In its plasmodial stage the slime mold may engulf solid food as does an animal. In its fruiting stage a slime mold is more likely to be found in an exposed sunny place. See McBride's "North American Slime Molds."

Order Cribrariales
Family Cribrariaceae

Cribraria
Cribraria dictydoides

Fruiting stage appears to be much like a bunch of light-colored spheres on the ends of tapering, slender, dull brown stems that may be erect or bent. Abundant on rotten logs or planks, particularly of oak or pine, from Pennsylvania to Nebraska.

Order Stemonitales
Family Stemonitaceae

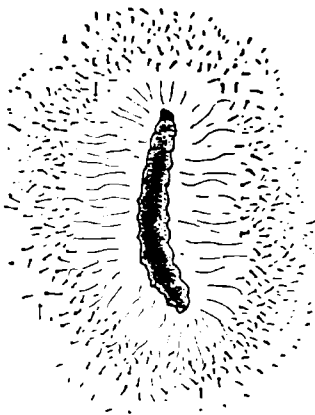
Stemonitis
Stemonitis webberi

Fruiting stage appears to be like a cluster of rusty brown feathers to $\frac{3}{4}$ in. long, naked at base and with midrib shining jet black and expanded at base. May be found on rotting wood, particularly abundantly in the Mississippi Valley and to the west.

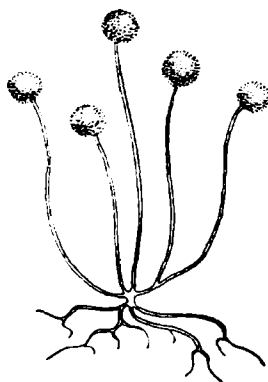
Order Lycogalales
Family Lycogalaceae

Lycogala
Lycogala epidendrum

Fruiting stage appears to be irregular olive to black, somewhat warted, depressed spheres to $\frac{3}{8}$ in. through, breaking irregularly usually near the top leaving thin, rough case. Commonest slime mold in wood, found everywhere on decaying woods.



Saprolegnia Sp.



Bread Mold



**White Rust on
Salsify-*Albugo***

DIVISION I. THALLOPHYTA.

Order Saprolegniales
Family Saprolegniaceae

Water Mold
Saprolegnia sp.

Appears most commonly as a gray fuzz on dead animals in water though frequently may appear on such fish as goldfish in a crowded aquarium. Members of the order are almost wholly aquatic, living mostly on dead animal matter or sometimes on plant matter. There are some 100 species in 16 genera. Reproduce by division, by swimming spores, and by an apparent or real sexual reproduction according to different authorities. May be a pest in fish hatcheries. Controlled by salt bath.

SUBDIVISION II. FUNGI.

Order Mucorales
Family Mucoraceae

Bread Mold
Rhizopus sp.

Appears commonly as a gray, webby mold on bread, spotted with black dots. Most abundant on decaying organic matter in humid environment where matter is rich in starches and sugars, but some species are parasitic on other fungi. Some 150 species have been described in the order. Reproduces by division, by freeing of air-borne spores from black-dot sporangia, or by regular sexual reproduction resulting from joining of elements. Serves as a decay hastener.

CLASS PHYCOMYCETES

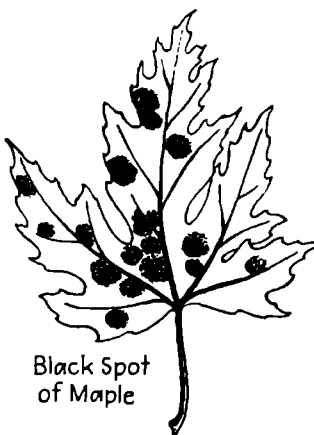
Order Peronosporales
Family Albuginaceae

White Rust on Salsify
Albugo sp.

Members of genus common as white blister patches on many kinds of plants, particularly the mustards. There are at least 300 species in the genus, all being parasitic on higher plants, non-aquatic, with air-borne reproductive spores and a complex sexual reproduction of different-sized reproductive cells. Important relatives include *Phytophthora infestans*, which causes late blight of potato, and *Pythium* sp., which causes common "damping off" disease of many garden plant seedlings.



**Downy Mildew
of Grape**



**Black Spot
of Maple**

Rhytisma acerinum on maple



**Witches' Broom
of Cherry**

CLASS PHYCOMYCETES

Order Peronosporales

Family Peronosporaceae

Downy Mildew of Grape
Plasmopora viticola

Appears as downy spot on any green part of grape, changing from pale green to yellow to brown with definite border, or as brown rot of fruits, in which case fruit wrinkles but does not become dry and hard as with black rot caused by *Guignardia*, which may cause 50% crop loss. Effective control is by early spraying with bordeaux mixture or ammoniacal copper carbonate or by similar spray after harvest to protect vines. Known also as "brown" or "gray" rot.

CLASS ASCOMYCETES

Order Protoascales

Family Phacididiaceae

Black Spot of Maple
Rhytisma acerinum

Appears as thick, irregular black spots that shine like tar, usually to $\frac{3}{8}$ in. across, on leaves in late summer causing leaves to fall early and definitely weakening the tree. Red maple and silver maple most commonly attacked, though Norway maple and sycamore maples also suffer in Europe. In spring, black spots in fallen leaves develop spores that are shot into air; so control is essentially that of burning infected leaves, though bordeaux spray helps infected nursery stock.

Family Exoascaceae

Witches Broom of Cherry
Exoascus cerasi

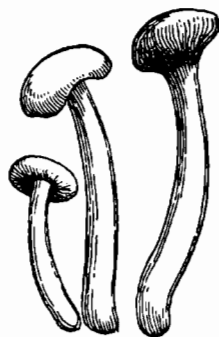
Appears as broom-like growths on English sweet cherry, sour cherry, wild black cherry, wild red cherry, choke cherry, and several kinds of plums. Fungus lives in twigs from year to year, attacking both bark and wood, stimulating bud growth, and causing deformity. After infected leaves fall, a whitish surface may develop on underside that may help spread disease ruining branches for fruit bearing. Some witches' brooms are caused by fungi and mites.



Peach Leaf-curl



Plum Pocket



Slippery Leotia

Leotia lubrica

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS ASCOMYCETES

Order Protoascales
Family Exoascaceae

Order Helvellales
Family Geoglossaceae

Peach Leaf Curl
Exoascus deformans

Leaves puff up and curl, with blade becoming thickened; leaves turn from green through yellow to red and finally to silver and may drop, stripping the tree. Found on peach, causing peach blister and appearing first in spring when leaves begin to puff. Annual infestation may cause death of tree and in some sections may seriously interfere with peach crop. Bordeaux spray or copper sulfate or lime sulfur is used, the last when insects are troublesome.

Plum Pocket
Exoascus Pruni

Appears after fruits fall; infected fruits become pale yellow, then covered with powder, then pockets turn black, and the fruit falls. Fruit is ruined, and pit becomes an empty thin shell. Infected trees may bear pockets year after year without near-by trees being affected even though every fruit on the diseased tree is affected badly. Treatment, which may not be effective, consists of cutting and burning infected parts or using lime-sulfur spray. Winters in twigs.

Slippery Leotia
Leotia lubrica

Found on ground on decaying wood in forest usually growing in clusters. Fruiting bodies are to over 2 in. tall, like slender tenpin, with expanded irregular sphere at top, hollow when old, slippery, and olive yellow. Stem not grooved as in the helvellas, more or less uniform in diameter throughout length, and either straight or curved. While the plant is edible and of good food value, it is not likely ever to be popular or of economic importance.



Morel
Morchella



Helvella lacunosa



Helvella crispa

Order Helvellales. Family Helvellaceae

Morel, Sponge Mushroom
Morchella sp.

Erect fruit body to 6 in. tall, hollow, pale flesh colored, brittle, tender, moist, not deeply penetrating ground. Found over most of United States in woodlands, mostly where there has been fire, from May to June but highly variable in different years. Spores shed best during damp and rainy weather. Excel all other fungi in food value but apparently not adaptable to controlled cultivation and may be infested with insects. When washed and fried in butter, they are delicious.

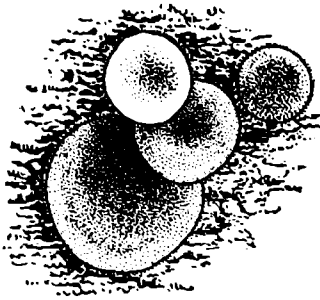
Helvella
Helvella lacunosa

Helvellas are usually smaller than the morels, appearing like deformed or sick morels, with smooth irregular caps and with long pitted stems. In this species the lower margin of the cap is close to the stem or grown to it. Fruiting tops appear in late summer and fall and plant is of wide geographic distribution. Related *Gyromyza* has cap with brain-like convolutions. Might be mistaken for a deformed morel and may be poisonous.

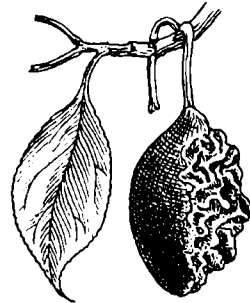
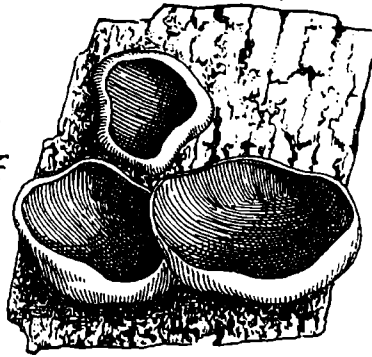
White Helvella
Helvella crispa

Much like *H. lacunosa* except that lower margin of cap is free from deeply furrowed stem and cap is white or whitish. Occurs in woods in summer and autumn. Helvellic acid found at least in related *Gyromyza esculenta* may be a violent poison; however, it is highly soluble in hot water, so suspicious looking morel-like plants may be considered as safe food if thoroughly cooked and repeatedly drained, even though it is better to leave them alone.

Shield-like Peziza



Scarlet Cup



Brown Rot
of Plum

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS ASCOMYCETES

Order Pezizales

Family Pezizaceae

Shield-like Peziza
Peziza contellata

Found on damp rotten logs from July to October, generally plentiful and beautiful when examined closely. Fruiting bodies become flat with age, are vermilion in center and paler at margin, hairy toward the margin, with straight black hairs. Fruiting bodies usually grouped in clusters of relatively small numbers and most evident in damp parts of season. Of no apparent direct economic importance.

Scarlet Cup
Peziza coccinea

Found on old sticks in open or in damp woods in early spring or late winter on ground, scattered or in groups and spectacular. Irregularly cup-shaped. Stem, if any, short. Cup to 2 in. across, with entire margin, with brilliant red interior and with flesh-colored pinkish-white outside. Fruits edible but almost too beautiful to eat. If allowed to stand quietly in warm dry room, clouds of spores may be freed by simply tapping the fruiting portion.

Family Helotiaceae

Brown Rot of Plum
Sclerotinia fructigena

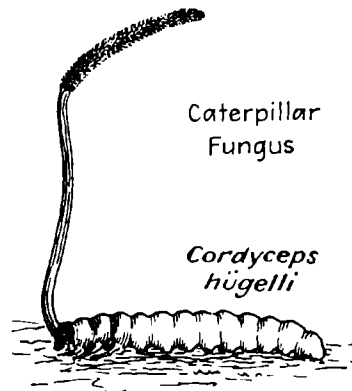
Common as brown rot on apples, plums, cherries, peaches, apricots, quinces, and pears, producing mummied fruits and wrinkled limbs. Parts of affected host become wrinkled and dry, showing first as brown rot. In spring affected fruits produce diseased fruit bodies that resemble stalked cups. Very destructive disease favored by moist, cloudy weather. Controlled somewhat by removal and burning of affected parts and by use of lime-sulfur spray.



Mildew on Lilac



Ergot



Caterpillar
Fungus

*Cordyceps
hügelli*

Order Perisporiales
Family Erysiphaceae

Powdery Mildew of Lilac
Microspheera alni

Appears as powdery white spots something like flour on the leaves of lilac. In late season, black dots appear scattered among the gray powder. These are fruit bodies that rupture to free reproductive units. In the North this is an unimportant parasite of lilac, but in the South practically an entire crop of pecans has been known to have been destroyed by this one fungus. Burning of infected refuse and spraying with bordeaux in early stages is standard control.

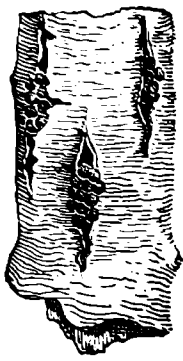
Order Hypocreales
Family Hypocreaceae

Ergot
Claviceps purpurea

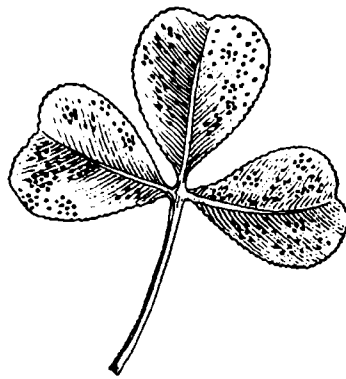
Appears as black or purplish body several times as long as the fruit of rye, wheat, oats, barley, quack or other cereals or wild grass that are affected. Many forage grasses also unfortunately may be infected. New plants are entered at flowering time. Grain and forage are ruined for fodder, since infected plants may cause abortion and other ill effects in cattle and other mammals. Used medicinally in treatment of migraine headaches. Too dangerous for home use. Burning is control. Infected seeds float in 20% salt solution.

Insect Fungus
Cordyceps sp.

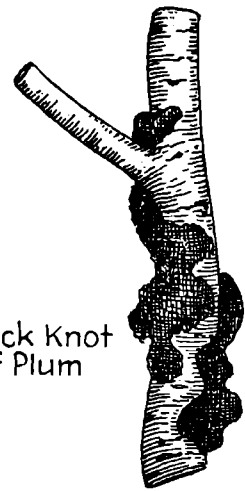
Appears as an "ergot-like" or club-shaped growth from caterpillars or pupae of various insects. Some species are found growing on different species of insects, while other species of the fungus may live on one or more species of insects. The fungus is parasitic, thus killing living insects and possibly being useful because of this. Some species live as parasites on other fungi that live underground. It rarely is of sufficient abundance or importance to be considered seriously.



Canker



Black Mold of Clover



Black Knot
of Plum

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS ASCOMYCETES

Order Hypocreales
Family Nectriaceae

Order Dothidiales
Family Dothidiaceae

Maple Canker
Nectria cinnabarina

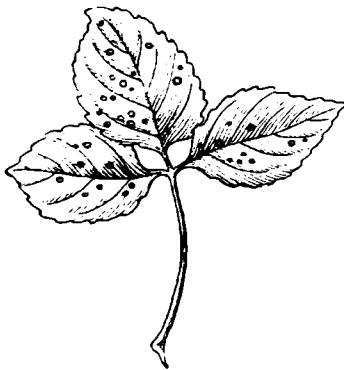
Appears as serious cankers that appear pinkish on the roots and branches of many woody plants including currant, horse chestnut, maple, apple, and quince. The organism gains entrance through a wound and eventually kills its host. Flesh-colored or pinkish hemispheres appear on bark, changing to chocolate brown, girdling the tree, and killing it; causes dark-green discoloration of sapwood. Control is by removal and destruction of infected areas and by painting of wounds.

Sooty Spot on Clover
Phyllachora trifolii

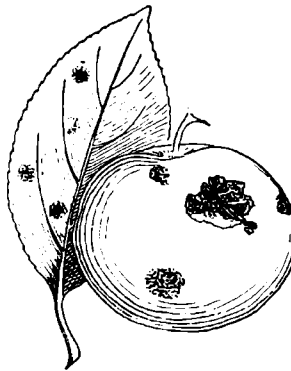
Appears as pale dots on upper leaf surfaces accompanied by black dots on lower surface on clovers such as red, crimson, alsike, and closely related species. The black spots closely resemble those made by the rust fungi and found in 3 stages widely distributed over the United States on at least 4 species of clover. While the sooty spot disease may cause much damage to clover forage, there seem to be no known effective control measures.

Black Knot of Plum
Dibotryon morbosum

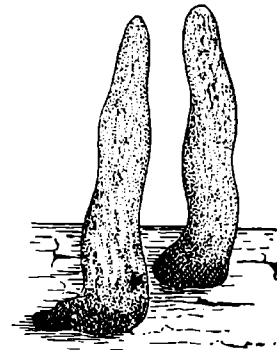
Appears as heavy, roughened, black knots on affected parts of both wild and cultivated forms of cherry and plum affecting the fine twigs or the trunk or limbs. In cherry the knot becomes finely honeycombed, and it may in any case give off gummy secretions. Affected areas may be to 1 ft. long. Disease is very dangerous and destructive. Control is by pruning out all affected areas before January when spores are freed, burning diseased parts, and using bordeaux in March.



Leaf Blight
of Strawberry



Apple Scab



Xylaria

Dead-man's Finger

Family Mycosphaerellaceae

Order Sphaeriales

Family Pleosporaceae

Family Xylariaceae

Leaf Blight of Strawberry
Mycosphaerella fragariae

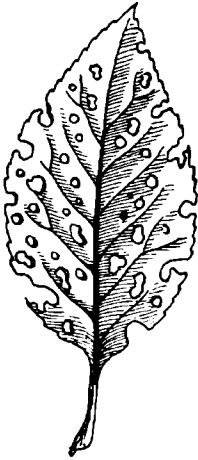
Appears first as red or purplish spots that enlarge and finally become white with red or purple borders, irregularly distributed. Found on leaves of strawberries most abundantly at about time of flowering. While it affects most varieties, Marshall and Brandywine seem to be somewhat resistant. Control measures consist of using resistant forms, planting healthy plants only, removing affected leaves, and using bordeaux just before flowering.

Apple Scab
Venturia pomi

Appears on leaves and fruits of apple as velvet-green spots that may eventually produce cracks and generally deform the fruit. A closely allied and somewhat similar disease of pear may affect the twigs and flowers as well as the leaves and fruits. Where apples are grown for market strong bordeaux should be used just before the flowers open, just after the petals fall, and again a week or two later, depending in part on the weather.

Dead Man's Finger
Xylaria sp.

Appears like an irregular, dark to black club to 3 in. long and with a maximum diameter of a little over 1 in., with a white corky interior, which shows when the brittle top is broken and exposes visible spore cases. Found on old woods in woodlands particularly around decaying stumps. It is highly variable in size, color, and form. While at least 2 species are associated with the rot of the wood of apple trees, the plants are not considered dangerous.



Shot-hole Disease of Cherry

Order Phacidiales
Family Phacidiaceae

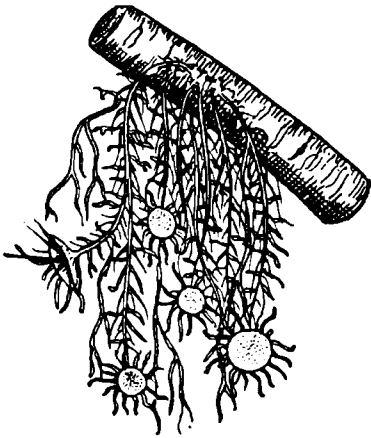
Shot-hole Disease in Cherry
Coccomyces sp.

Leaves at first appear to be shot full of holes because of the dropping out of the fungus-destroyed tissue, tissue that is transparent before the holes appear. Disease is found on the leaves of cherries, plums, and their kind except in the case of a few resistant varieties. Disease organism is frequently considered as *Cylindrosporium padi* of the imperfect fungi (p. 69). May cause much loss. Control is early spring bordeaux spray.

THE LICHENS

Since the lichens are a combination of two plants of widely different relationships, it is difficult to classify them. Usually they are considered as basically the more conspicuous and more easily identified fungus that uses the less conspicuous and less easily identified alga to supply it with necessary food. The fungus provides support and water for the alga and the alga provides food for the fungus. This is a true symbiosis in which both organisms live in a mutually dependent relationship. The fungi are all ascomycetes and the algae are usually related to the *Protococcus* group described on p. 41.

Lichens are found in a great variety of places—hanging from twigs or wires, clinging closely to bare rock, grown into the rough bark of trees, forming mats on otherwise bare soils of many kinds. Since they usually are most rapidly developing early in the season, they are at their best in spring. In the arctic regions, they constitute a bulk of the flora and the basic food for the animals that live there. Reindeer moss is probably the best known of these arctic lichens. It is an essential food not only of reindeer but of lemmings, which are basic food for the fur bearers. Lichens are soil formers, have been used as sources of medicines, foods, dyes, and other valuables. They anchor soil in some cases and have figured in many whimsical legends.



Old Man's Beard

Old-man's-beard
Usnea barbata

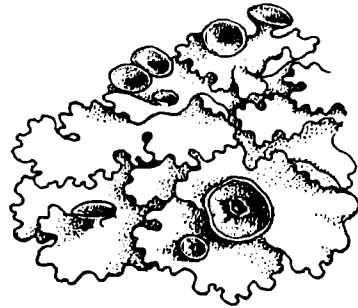
Apparently made of numerous branching, radiating fibers of the same color, often green, with units round in cross section. Found hanging on bark and branches of living or dead trees in all parts of North America and many parts of the world. Fruiting bodies shield-like with a lighter disc. Fibers to over 4 in. long. Described by Theophrastus, who lived in 300 B.C., as being useful to stimulate growth of hair though no such merit is now recognized.



Hanging Moss

Hair-like Usnea
Usnea longissima

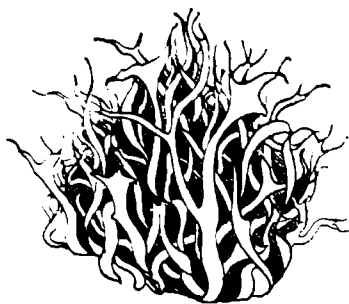
Appears like hanging gray threads that may be to 5 ft. long, round in cross section, soft and flexible. Often inhabited by insects. Found on tree branches and bark in the northern United States, Alaska, and British Columbia, especially in the humid mountainous regions. The interior is a tough strand surrounded by a spongy material. Fruit bodies are small discs with a few marginal threads. The name is derived from the Arabic term meaning lichen.



Parmelia

Parmelia
Parmelia sp.

Appears like sheets of crumpled leather attached by black "roots" to rocks or trees. If torn, will show white fibers in the center under a hand lens. Sometimes has a powdery appearance owing to ruptures associated with freeing of the reproductive organs. Fruiting bodies are in the form of discs or cups, usually with a raised center, that appear scattered over the lichen's surface. Plant is an encrusted lichen that grows slowly and is at best on a long-undisturbed base. Helps make soil.



Physcia
leucomela



Pyxie-cup Cladonia



Scarlet-crested
Cladonia
British Soldiers

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS ASCOMYCETES
THE LICHENS

Physcia
Physcia leucomela

Appears like narrow, leaf-like structures irregularly divided, smooth, with marginal hair-like structures, white beneath, and generally more or less tangled into irregular masses. Some botanists put this lichen in the family Physciaceae in an order Discolichenes, an order to which all the lichens here considered belong and in all of which the alga involved is a *Protococcus*. In a few of the families in the order the alga involved is a *Nostoc*, namely, in *Peltigera*, *Sicta*, *Parmelia*, and so forth.

Pyxie Cup Cladonia
Cladonia pyxidata

Appears to be somewhat scale-like, bearing at intervals grayish, scaly fruit bodies that are hollow and seem like stalked, expanding, erect cups that rise to a height of 1 in. and look like plugged funnels with widespread margins. Plants are found on the earth or on such old dry wood as fence rails. The alga concerned is a *Protococcus*, and the family is sometimes considered as the Cladoniaceae, some of which have blue-green algae involved.

Scarlet-crested Cladonia
Cladonia cristatella

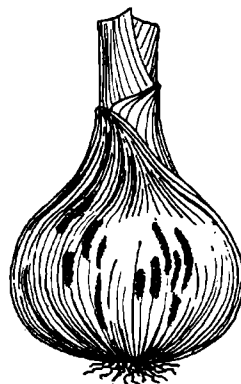
A scale-like broken base produces a number of erect, branched, hollow standards that terminate in bright red, sometimes glistening knobs that are the fruiting bodies. The plant is in most conspicuous fruiting condition in early spring, when it is greener, redder, and obviously more active. It occurs on the ground or on dead wood. It has a common name of British soldiers, referring possibly to the red "uniform." Plant is excellent for indoor terrariums.



Corn Smut



Oat Smut



Onion Smut

CLASS BASIDIOMYCETES
Order Ustilaginales

Family Ustilaginaceae

Corn Smut
Ustilago zae

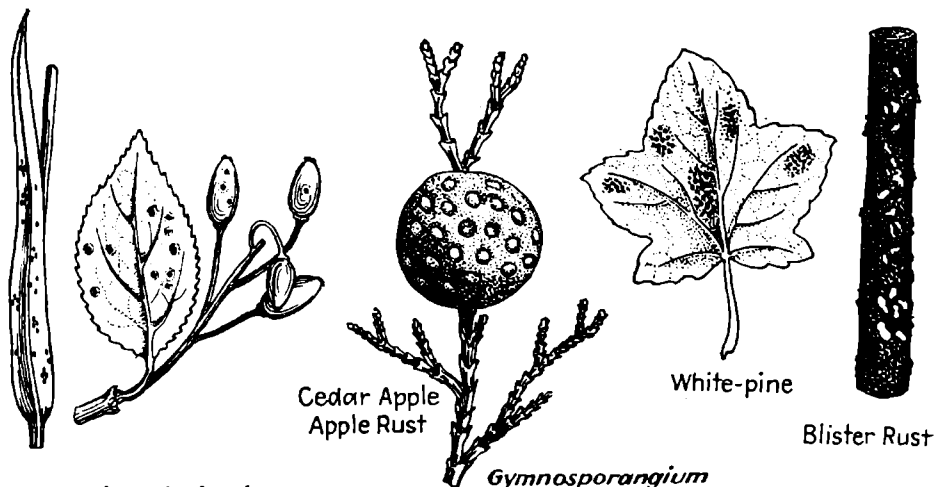
Appears first as large, glistening, white blisters that later become dark and burst to free masses of dark spores that are spread by the wind. Found on ears, stems, and leaves of corn particularly during or after a moist season, especially in a long-growing or rich soil or where a crop is too crowded. May destroy as much as $\frac{3}{4}$ of a crop. Control is effected by removal of infected parts from crop, avoiding use of infected manure, and by treatment of seed.

Oat Smut
Ustilago avenae

Causes heads of oats to become black and prevents grain formation. Enters plant at time of seed germination and when oat is in flower by means of wind-blown spores. Appears to mature at about time of flowering of oat. While it affects the whole plant, it is observable superficially only in the heads. Control is effected by dipping seed in 1 pt. of formalin to 30 gal. of water for 10 minutes to destroy spores, then drying.

Onion Smut
Urocystis cepulae

Appears as dark streaks on bulb and leaves of onion. These break, freeing spores into the ground, and these infect new onion plants grown in that ground. Infection takes place independent of climatic conditions once the soil has become contaminated. Common control practices include care in transplanting healthy plants into clean soil, avoiding repeated use of same soil for similar crop, or drilling soil with 2 parts of sulfur to 1 part of air-slaked lime.



Black Rust of Oats

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Uredinales

Family Pucciniaceae

Family Melampsoraceae

Black Rust of Grain
Puccinia graminis

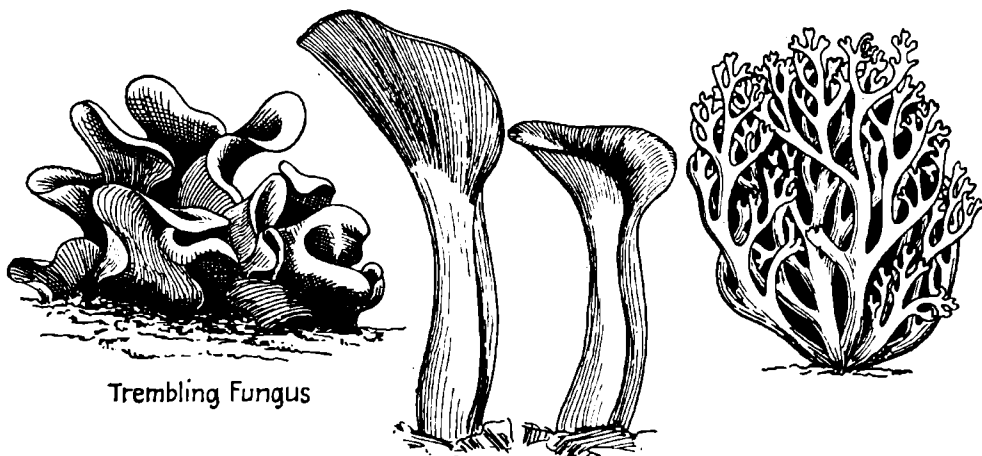
On the leaves of European barberry may be found scars on upper surface and clusters of yellow cups on under surface. Spores from these blow to grain and develop a plant body that goes through the plant, weakening it and eventually breaking the surface of many important cereals and many forage grasses, appearing as yellow or reddish streaks, whose spores further spread disease. Later, black spots develop to start cycle again on barberry.

Cedar Apple, Apple Rust
Gymnosporangium sp.

Rusty spots may appear on the leaves of apple on underside as clusters of cups with corresponding yellow spots on upper surface. These injure health of apple and free spores that blow to red cedar where, after development, great orange jelly-like structures appear in spring and early summer. Spores from these are carried to apple and start cycle again. Fruits of apples may be affected. Control may be helped by removal of infected red cedars.

White-pine Blister Rust
Cronartium ribicola

Pine infection appears in spring as yellow-orange blisters on young twigs, older branches, or sometimes on the trunks of white pine. From these the spores are carried to currant or a related plant, where, after development, structures are developed that spread spores back to pine again to start a new infection. Control by removal of infected areas and destruction of currants in vicinity of pines. Disease may completely destroy white pines in area.



Trembling Fungus

Gyrocephalus rufus

Clavaria formosa

Order Tremellales
Family Tremellaceae

Order Hymeniales
Family Clavariaceae

Trembling Fungus
Tremella frondosa

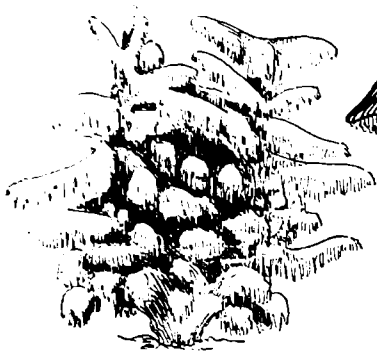
Appears like soft, clammy, yielding folds of jelly-like material up to 4 in. high and to 5 in. wide, brown and glistening. Found on rotten wood at any time from fall to spring, with various species differing in color and in shape. Spores are given off from the surface since there are no pores or gills. This species is sometimes known as "witches' butter"; while it is edible, it is of no great economic importance as food or plant disease.

Gyrocephalus
Gyrocephalus rufus

Appear like erect stems with shoehorn tips or like irregular funnels usually undeveloped on one side, reddish-yellow, smooth, clammy, gelatinous, to 4 in. tall. Found growing on the ground in woods, most commonly from dead roots or other rotting wood, and becoming very hard when dried artificially. Most commonly found developed at best in autumn. Not considered as edible or of any economic importance. Probably serve as an eliminator of dead wood.

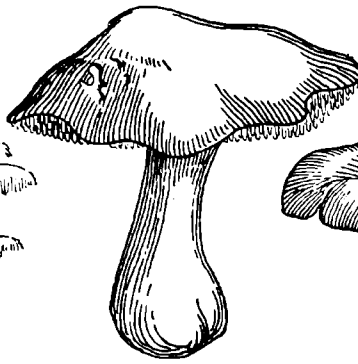
Coral Fungus
Clavaria sp.

Upright, repeatedly branching, with tips always pointing upward in contrast with downward-pointing hydnum. Height to 8 in., brittle, pink, red, orange, or yellow. Widely distributed. Spores borne by whole upper surface and may be carried by insects. Some grow from ground, others from rotting wood. None are poisonous; many are edible, few delicious. Usually tough; some have disagreeable flavor. Should be cooked slowly, then fried in butter to taste like noodles or put in soups.



Coral Hydnum

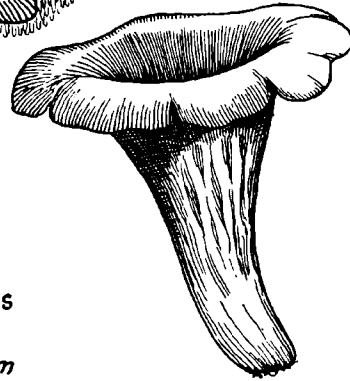
*Hydnum
coralloides*



Hedge-hog Fungus

Hydnum repandum

*Craterellus
cornucopioides*



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES

Order Hymeniales

Family Hydnaceae

Family Thelephoraceae

Coral Hydnum
Hydnum coralloides

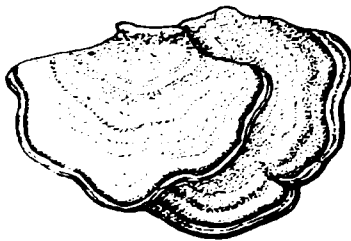
From a common stem many long branches arise; from anywhere beneath the surface of these branches hang spines to $\frac{1}{4}$ in. long. Single fruiting body may weigh over 1 lb. Found only on decaying hardwoods, while related bearshead hydnum *H. caput-ursi* is found on living or on dead hardwoods and has long teeth grouped from beneath ends of branches. Remarkably free from insect pests; both species are edible. May be bitter, but not if boiled slowly.

Hedgehog Fungus
Hydnum repandum

Pore surface like preceding but under 4 in. tall, with white, buff, or yellow cap with downward-hanging, white, brittle, spore-bearing teeth. Found commonly in woods, on ground, variable, but usually with supporting stem in middle though some are from one side. Considered one of the very best table mushrooms and safe because no closely resembling species are poisonous. *H. putidum* has a coarse, spongy stem and, when fresh, has an offensive odor. All species may be found repeatedly in one spot.

Craterellus
Craterellus cornucopioides

Has appearance of a deep funnel with a broad hornlip. Undersurface of horn is the fruiting surface, which is uneven, dark, smoky in color. Found on the ground in the woods most commonly in late summer and autumn. Differs from *Cantharellus* (p. 65) in that the undersurface is smooth when the plants are young while in the canterelles it is covered with folds. This species is darker than *Cantharellus cantharellus* and has a more uneven undersurface than does that species. Both are edible.

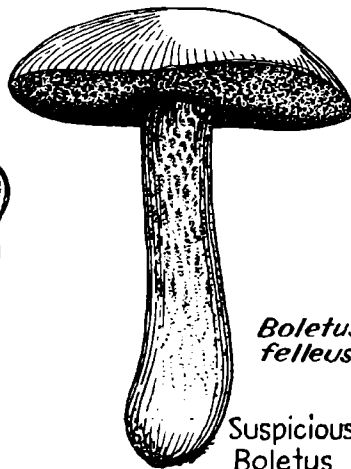


Stereum versicolor

Family Thelephoraceae

Stereum
Stereum versicolor

Thin, woody, leathery shelves that grow crowded together with upper surface distinctly marked with eccentric rows of different shades of gray to make easily recognized zones. While it somewhat resembles *Polyporus versicolor* (p. 61), the undersurface of this species is smooth, even, and not composed of fine, closely crowded pores. Fruiting bodies woody and therefore not edible. Plant serves as a wood rot. Silver-leaf disease of forest and shade trees is caused by related *S. purpureum*.



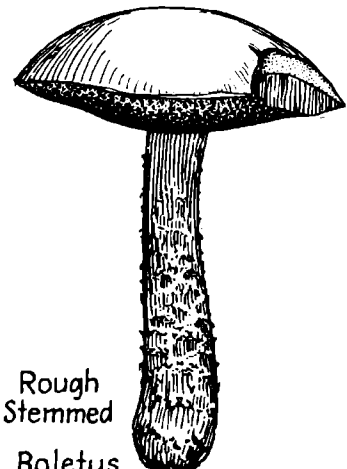
Boletus felleus

Suspicious
Boletus

Family Polyporaceae

Suspicious Boletus
Boletus felleus

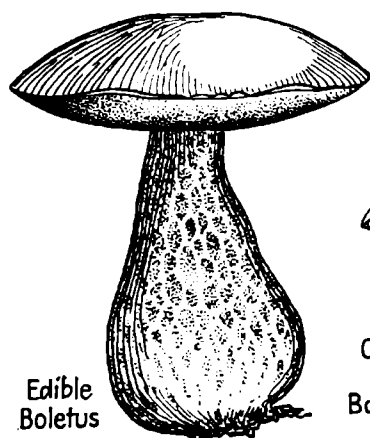
Cap to 8 in. across; nearly flat, smooth, yellow-brown, with white flesh that may turn pink where wounded. Tubes on underside are white when young but flesh-colored when mature. Found on or near decayed logs, usually near hemlock or spruce but sometimes in open fields. Most common in July, on through September when the season is wet and warm. This species is too bitter to be edible, but it is doubtful whether it is poisonous. Some forms are to 6 in. tall.



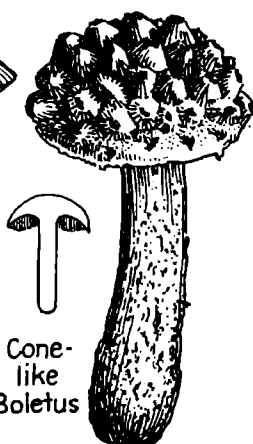
Rough
Stemmed
Boletus

Rough-stemmed Boletus
Boletus scaber

Cap white, red, brown, or smoky, from 1-3 or more inches across, with flesh that is soft and white but turns dark when bruised. The free ends of the downward-pointing tubes form a white convex surface, and the tubes are free from each other or nearly so. Stem rough appearing, giving the species its name. Found in woods or in grassy places, on the ground. This species is edible and lacks the bitter taste of *B. felleus*. By some, it is considered to be excellent food.



Edible
Boletus



Cone-
like
Boletus



Sulphur Polypore

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales
Family Polyporaceae

Edible Boletus
Boletus edulis

Fruiting body umbrella-form, with cap from 4-6 in. across, broad, smooth, grayish-red to brown, with flesh that is white or yellow and is red under the skin. Tubes white at first, but as they mature they become greenish or yellowish; free from each other or nearly so. Stem rather stout, swollen at base and to 7-8 in. long.

Members of this genus differ from *Fistulina* and *Polyporus* in that pore-bearing layer easily separates from flesh of cap. While these layers will usually separate from cap in *Boletinus* and in *Strobilomyces*, they do not do so easily. This species is found in woods or in open places particularly in warm weather from July through September. Found on the ground in each case.

Spores shed downward through pores in cap when mature. Thousands of spores may be expelled from a single pore, and there are probably thousands of pores in some caps. Spores are wind-borne. When they fall on a suitable food supply, they develop into the plant that bears the fruits.

Usually not found in fruit in great numbers at any one spot. Widely distributed both in America and in Europe. When eaten raw, it tastes like a nut or has a distinct sweetish flavor. Since tubes may become slimy with age, they may be discarded and the rest of the cap saved for eating.

One of the more desirable fungi for food and in Europe is considered a distinct delicacy. The caps are sometimes sliced and dried for later use in soups or as a regular mushroom dish. They may be eaten raw or fried in butter to give body to a soup much as noodles do.

Cone-like Boletus
Strobilomyces strobilaceus

Fruiting body like a coarse umbrella, with cap to 4 in. across, soft and spongy, with surface covered with coarse, hairy, upright, blackish-brown scales, with margin scale-fringed and undersurface crowded, with pores that are white at first but changing to black when wounded and having angular openings. Stem to 5 in. long and to $\frac{3}{4}$ in. thick; brittle.

Strobilomyces differs from *Boletus* and other common fleshy pore-bearing stool-shaped mushrooms in that tubes are white, are at first covered by veil, and do not separate easily from cap as they do in *Boletus*. Flesh of pine-cone fungus, which is at first a pale tan when broken, becomes a dark blue in few minutes and exudes a reddish-brown juice. Pores to 1 in. long. Stem less woolly than cap.

Spores shed downward from pores when fruiting body is in its prime in fall and summer. While mature fruit body may become soft and decayed, old one may become dried, black, and resemble a piece of dead wood. Spores dark brown in mass, nearly globular, and roughened.

Found on ground, not usually in great numbers but over most parts of country and into Canada. Stem and cap are favored hosts for larvae of many insects, and so specimens should be examined carefully before they are used as food by man. Rather rapid color change may be used as some index of relative freshness of plant.

Not easy to confuse this plant with any poisonous species. Not likely to be sufficiently abundant anywhere at any time to make up an important part of the volume of any collection. This is the most common one in United States and Canada. Related species are found in Europe.

Sulphur-colored Polyporus
Polyporus sulphureus

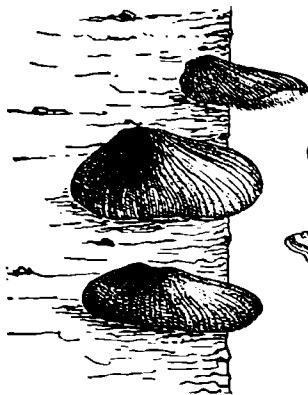
Fruit body appears as bright red shelf or series of shelves, the lower of which are usually larger with undersurfaces crowded with round pores. Older shelves show radiating furrows and ridges that create a fan-like effect for whole fruiting body, and in the older shelf the rim is thin.

Family includes a variety of forms, some umbrella-like, as in *Strobilomyces* and *Boletus*, and many shelf-like or even plate-like but all marked by crowded pores on undersurface of the fruiting body. Related beefsteak mushroom, *Fistulina hepatica*, has soft, fleshy shelf that is juicy and blood-red when young but tough and hard when old. Other genera and species in family are always hard or woody.

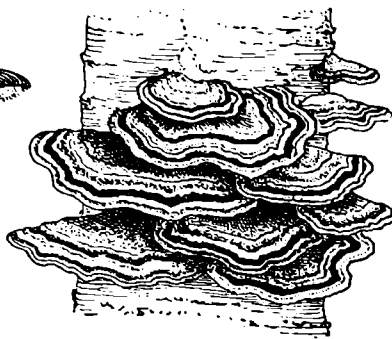
Spores shed from downward-pointing pores, new layers of which may be formed in succeeding years in suitable weather conditions at $4\frac{1}{2}$ million per square inch per hour, or 375 million per week. Wood rotted by fungus resembles red-brown charcoal, with concentric and radial cracks filled with large sheets of fungus.

Lives on woody plants that are alive or dead, favoring cone bearers, oak, cherry, maple, chestnut, butternut, walnut, alder, locusts, apple, pear, but is also found on other trees. It fruits in fall when summer droughts have passed and appears year after year on same logs.

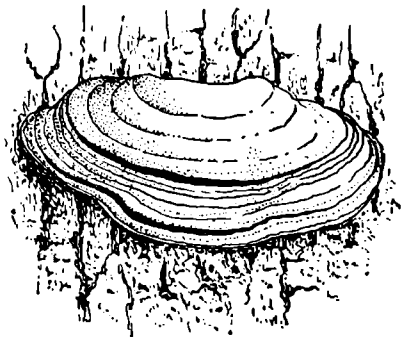
Fruiting shelves cannot be confused with any poisonous mushroom and if collected young, parboiled in salt water, and fried in butter have a delicious taste. Older shelves are tough. The plant is, of course, a pest to a tree and it may be desirable to burn infected logs to protect healthy trees.



Cinnabar
Polypore



Yellowish
Wood-rot



White Butt-rot

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales
Family Polyporaceae

Cinnabar Polypore
Polyporus cinnabarinus

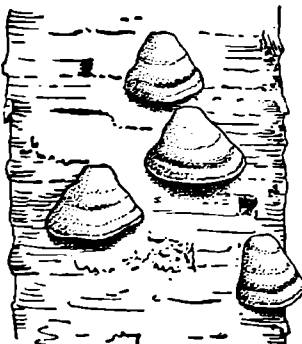
Conspicuous, vermilion-colored shelves that are dry, more or less spongy, to nearly 1 in. across, with light or yellowish-red flesh. Pores are, of course, densely crowded on lower surface. Found most commonly on the dead branches of oak, cherry, or maple, particularly late in autumn. Shelves are merely fruiting bodies of a plant that is buried in wood acting as the host. Too woody to be considered edible. Not considered an important plant pest.

Yellowish Wood Rot
Polyporus versicolor

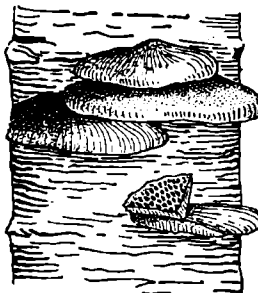
Rather thin, leathery, somewhat flexible shelves, plain and sometimes rigid, velvety above with adjacent zones of different shades of coloration showing conspicuously. Pores very minute. Found commonly crowded on dead logs at any time of year. Destructive to certain trees even though it attacks dead wood only. Since it destroys wood quickly, it reduces strength of whole tree, which eventually falls through weakness. It resembles *Stereum* (p. 59).

White Butt Rot
Fomes applanatus

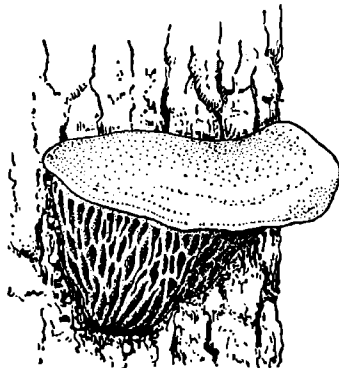
Shelves hard and woody and flexible only at growing edge temporarily. Top is marked with eccentric ridges marking year's growth. Pore surface beneath always points downward and is white unless rubbed. Found growing on living or dead trees, particularly beech, maple, birch, oak, and poplar, at any time of year. Fruiting bodies increase in size in succeeding years. Plant is highly destructive to valuable trees.



Yellowish Sapwood Rot



Favolus
canadensis



Daedalea
quercina

Yellowish Sapwood Rot
Fomes fomentarius

Exceptionally hard, thick shelves that look somewhat like the hoof of a horse and do not extend far from surface of host. Each succeeding year's growth is marked by an increase in size of the fruit body as a new layer is added at bottom; many fruiting bodies may appear relatively close together on a badly infected tree. Found on beech and birch most commonly and of course can be found at any time of year. Recognized as a serious beech and birch pest.

Favolus
Favolus canadensis

Usually fruiting body is supported by a stalk from one side. Cap tough, fleshy, thin with pores large, angularly elongated, and with their greatest width extending radially from the stalk. Plant common on fallen branches particularly of hickory. Fruiting bodies are most common from September until the frost. Interesting because pores begin to suggest gills. Name refers to honeycomb appearance of undersurface of cap.

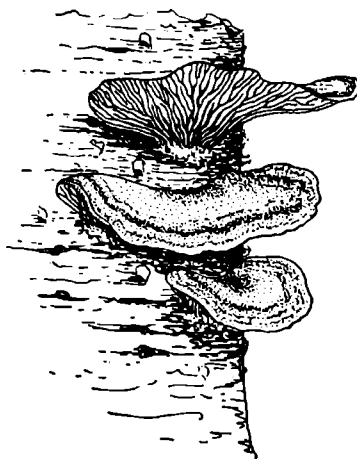
Daedalea
Daedalea quercina

Pale, wood-colored shelves of considerable thickness where in contact with the host. Pores at first round but with maturity become apparently stretched to form definite labyrinths. Not easily confused with other species. Found on oak stumps or fallen oak logs at any time of year, often with many fruit bodies rather close together. Shelves may be to 4 in. or even more broad. Since plant does not attack living trees, it is not considered of economic importance.

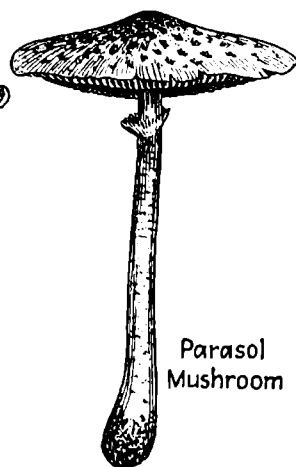


Beef Steak Mushroom

Fistulina hepatica



Lenzites betulina



Parasol
Mushroom

Lepiota procera

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales

Family Polyporaceae

Beefsteak Mushroom
Fistulina hepatica

Easily recognized as great red shelves supported by stalks from one side. With pores on undersurface yellowish and distinct, relatively inflexible. Shelf has a tendency to turn up at edge showing yellow undersurface contrasting with red upper. Shelf is about 8 by 14 in., and stem may be wanting. Found on dead trunks of oak, chestnut, and other hardwoods from June through September whenever the season is a wet one. Edible but sour.

Lenzites

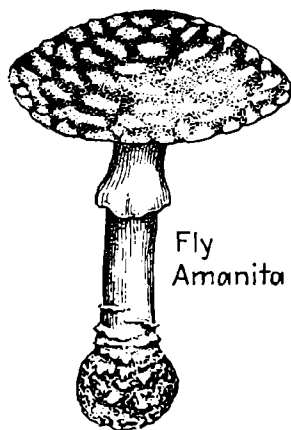
Lenzites betulina

Corky, leathery brackets that are firm and do not show growth zones on upper surface, of uniform color, dirty grayish-white, with pores almost gill-like and certainly not typically tube-like. Found in a variety of forms on many kinds of trees but usually more abundant on birch; of widespread distribution. Some botanists consider this a member of the next family, the Agaricaceae, because of the gill-like pores. It is apparently of no great economic importance.

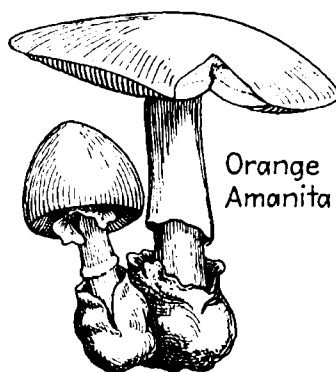
Parasol Mushroom

Lepiota procera

Height to 8 in. Cap to 5 in. across, brownish spotted, but usually darkest at tip, which is often well-raised. Gills free from stem, white, soft, and dry. Cap easily separates from stem, which has a swollen base, with white flesh and a free separate ring but no basal cup. Found in thin woods, by roadsides, in open pastures from July through September. In older plants cap may be cracked at margin. Edible.



Fly
Amanita



Orange
Amanita



Destroying
Angel

Family Agaricaceae

Fly Amanita
Amanita muscaria

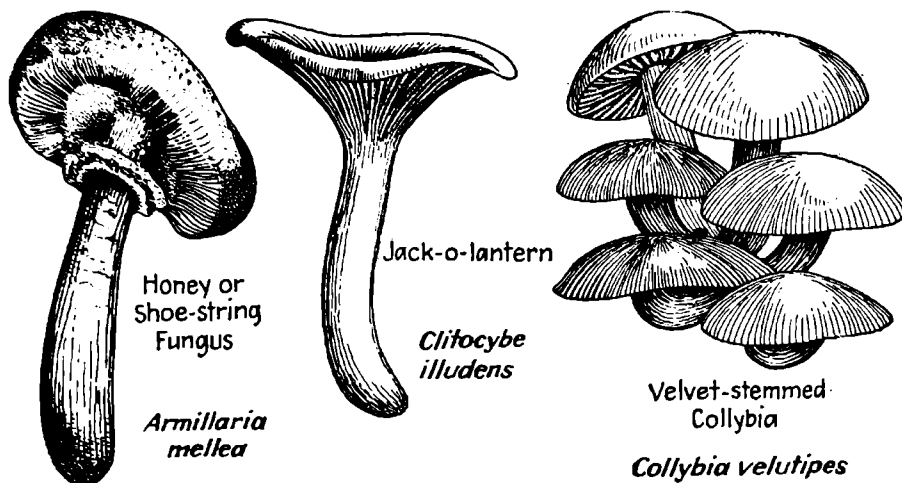
Beautiful, with 6-in. cap, changing from spherical to convex to plane, yellow to deep orange, with striated margin, with sticky surface covered with thick angular persistent scales. Stem white or yellow, with ring and conspicuous cup. Found from June to November on ground, in open or in woods, rarely in great numbers. Closely resembles delicious Caesar's mushroom or orange amanita but is deadly poisonous, effect showing in 3-4 hours after eating. Take salts, and call doctor.

Orange Amanita
Amanita caesarea

Cap red or yellow or orange, bell-shaped, with gills yellow and free from the stem, which is hollow, arises from a free-bordered cup, and bears a broad collar-like ring. Cap is generally naked or bears broad, thin patches, has a smooth surface except at margin, where it has definite striations. Color deepest at apex. Found in woods, on ground in spring and summer. Is edible but should ordinarily be avoided because of its close resemblance to deadly poisonous species.

Destroying Angel
Amanita verna

Cap white, egg-shaped at first but becoming flat, sticky. Stem erect, stuffed when young and hollow when mature, tall; arises from a cup and bears a broad collar-like ring, longer than width of cap. Found in woods from spring to fall. Probably our most poisonous fungus. Poison becomes evident about 40 hours after it is taken, causing pain, muscular paralysis and death in 2-3 days or earlier. Clean intestinal tract quickly and thoroughly to help.



DIVISION I. THALLOPHYTES. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales. Family Agaricaceae

Honey-colored Armillaria
Armillaria mellea

Fruiting bodies to 12 in. tall, with cap to 8 in. across and stem to nearly 1 in. in diameter. Usually honey-colored but sometimes white or dull reddish-brown, being darker in center of cap, which is usually covered with dark-brown to blackish scales though these may be absent. Usually many fruits in clusters.

Differs from *Amanita* and *Lepiota* in that cap does not break cleanly and easily from stem, the tissues of the two being continuous. Stem usually bears a ring (annulus) though this is not always distinct. No cup (volva). Presence of annulus separates it from related *Tricholoma* and *Clitocybe*, in both of which stem and cap are grown together. World-wide in distribution.

Spores shed in summer, attack roots of host trees, entering bark and spreading under bark until roots are killed, and spreading until eventually tree is killed. Growth may take place for many years before new fruiting bodies are produced, the hidden tissue often appearing as cords or strands.

Host plants include many cone bearers as well as forest trees and small fruits. In newly cleared lands, the diseased roots of forest trees may infect newly planted orchard trees or other cultivated woody plants. The dark subterranean cords may spread infection from tree to tree.

Economically injurious to important woody plants, destroying timber and reducing fruit production. The fruit bodies are considered edible but not choice as they are too tough. Often appears in large numbers after first killing frosts and may be canned for use as food.

Clitocybe, Jack-o-lantern
Clitocybe illudens

Fruiting body borne in clusters arising often from a common point, with stems to 5 in. long and $\frac{1}{2}$ in. thick. Cap to 5 in. across with raised portion in center when young, or depressed when old; margin often waxy. Whole plant a bright saffron yellow though flesh inside is soft and white or yellow.

Lacks both ring and cup; stem and cap are grown firmly together. Unlike otherwise rather similar *Tricholoma*, gills at their bases extend down onto stem. Many species, including edible, mealy-surfaced *C. laccata*, short-stemmed giant *Clitocybe*, ivory *Clitocybe*, the funnel-shaped, the lacquered, the cloudy, the fragrant, the clustered *Clitocybes*.

Like *Armillaria*, some *Clitocybes* may spread through cords from root to root underground. The spores are shed from the fruiting bodies and can attack wounded woody plants and there develop new plant bodies that may eventually bear other fruit bodies. Spores, white.

C. illudens is most conspicuous at base of decaying stumps and at night is often luminescent. Wood being rotted by this fungus may be collected and used to supply an eerie light in a tent while camping, though the luminescence is most conspicuous in wet weather.

A wood-destroying fungus. Supposed to be poisonous or unwholesome, though bad element is apparently destroyed or removed by boiling. Soldiers in North Africa have written of excitement caused at night by steady glow of infected roots cut in trenches in front lines.

Velvet-stemmed Collybia
Collybia velutipes

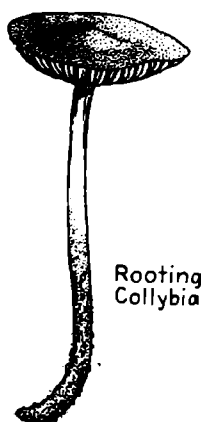
Fruiting bodies appear in crowded masses on trunks of trees with stems bent upward, to 5 in. long, yellow when young but densely covered with brown velvet when old and bearing caps that are to 3 in. across, at first red-brown, then tan, then glistening with sticky gelatinous substance. Gills, white, narrow, crowded.

Collybia differs from *Mycena* in that cap margin in *Collybia* is at first bent inward rather than straight, gills of neither are decurrent, and although cap and stem are grown together, they are of obviously different texture. White-spored, with relatively thin gills. Related *C. radicata* grows on ground with flat cap and root-like base to stem. Both common and well-distributed.

Spores from this plant may be shed from the fresh fruit bodies from earliest spring even into January, it being one of the fungi appearing most widely spaced through the year. Fruit appears either from dead trees or from wounds or dead spots in living trees.

Plant may injure living trees by destroying the old wood that provides support. A favored species is basswood though it is found frequently on other hardwoods. The fruiting is most vigorous in late fall and winter; late records are probably of persistent fall specimens.

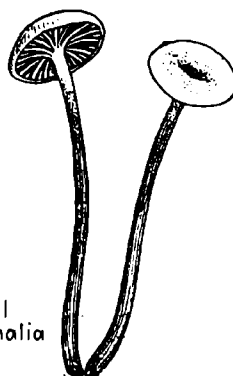
Plant injurious to woody plants but fruiting bodies provide excellent food for man. They may be collected and eaten fresh, fried in fat, or canned and used later in season. The related *C. radicata* is also edible but not usually so abundant.



Rooting
Collybia



Bell
Omphalia



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales. Family Agaricaceae

Rooting Collybia
Collybia radicata

With white to gray caps that are sticky when wet. Stem has a cartilaginous bark that is somewhat brittle and extends into a slender root nearly equal to the length of the stem above ground. Gills uncrowded and grown fast to stem. Cap to 3 in. across, stem to 8 in. tall and to $\frac{1}{2}$ in. thick. Flesh white. Found on ground in woodlands or at their edges usually in tufts into late fall even after the frosts and usually around old stumps. Edible and not confused with bad forms.

Mycena
Mycena galericulata

Height to 5 in., but caps are rarely over 1 in. across and stems are slender and to $\frac{1}{4}$ in. through. Cap has distinct elevation near center, is bell-shaped, brown or gray. Gills extend downward on stem by means of a tooth, are white or flesh-colored and not crowded. Stem hollow, with hairy base, cartilaginous. Abundant in woods generally in dense clusters from September until after frost. Edible, but too delicate to provide a substantial meal.

Bell Omphalia
Omphalia campanella

Height to 2 in. Cap to 1 in. across; with distinct depression in center, smooth, rusty yellow. Gills run down stem at point of attachment. Stem watery, hairy at the base, hollow, brownish, slender, and often curved upward rather than straight, lighter at top. Found in woods in damp locations, usually abundant from summer through fall. These mushrooms are delicious though they are difficult to collect in quantities to make a meal.



Oyster Mushroom



Elm Mushroom



Oyster Mushroom
Pleurotus ostreatus

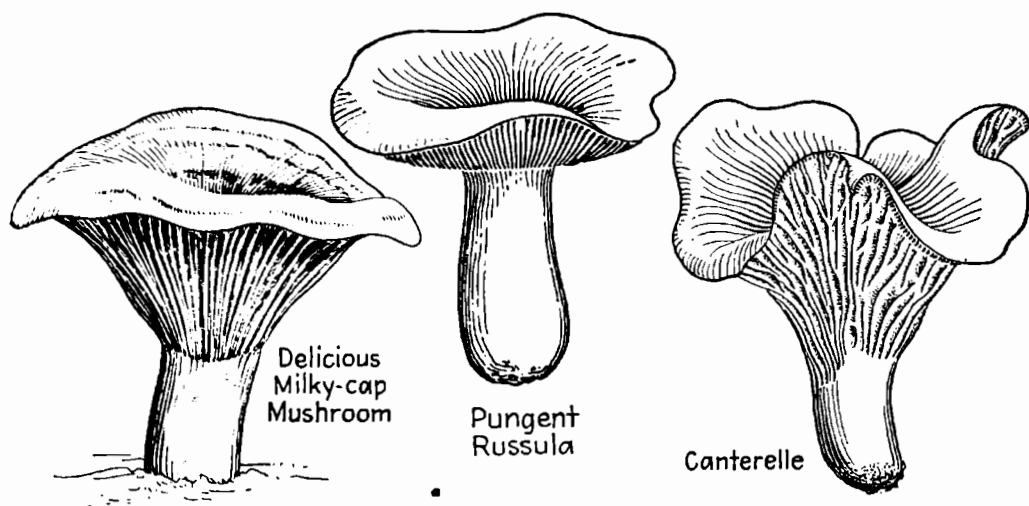
Cap may be over 8 in. across, with top white or ivory and smooth, usually developed unevenly to one side of a short thick stem, or there may be no stem. Gills thin, white, soft, spongy and extend down onto stem; thicker than in *Hygrophorus* and not waxy. No ring or cup. Found usually on hardwoods. Caps are usually infected by active beetles that crawl in gills. Caps decay rapidly in wet weather. Edible, particularly when young.

Elm Mushroom
Pleurotus ulmarius

Much like oyster mushroom, but with stem often central. Gills do not run down stem at point of attachment, and stem is generally conspicuously thickened at base. Gills and cap usually not so heavily populated with insects and slugs as are those of oyster mushroom. This species lives on elms living or dead, and may often be collected from city street trees in quantity enough to make a good meal. When properly prepared, are delicious.

Hygrophorus
Hygrophorus sp.

Cap sticky, waxy, either sooty, orange, yellow, or other colors. Gills relatively few, waxy, and broadest nearest cap, in some species extending down stem and grown fast to it. No ring and no "death cup." While gills appear to be waxy or watery and have a surface that can be peeled off relatively easily, they do not bleed when ruptured. Fruiting bodies are found growing in woods and on lawns. Apparently there are no species that are dangerous to eat.



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales. Family Agaricaceae

Delicious Milky Cap
Lactarius deliciosus

Fruiting body a stool-like body that, when bruised, gives off a milky or colored juice. Cap sticky when moist, to 4½ in. across, convex when young but funnel-shaped when old; mottled orange to red or changing to green with juice similarly colored. Flesh soft, spongy, brittle, white to orange. Gills extend down stem. Stem to 3 in. long.

White-spored, resembling russula but differing primarily in possession of colored or milky juice, which exudes freely in plant or more particularly in broken gills. Gills brittle, rigid, may or may not extend down stem in different species. Important species include the scented, the flesh-colored, the watery, the peppery, the indigo, the coral-colored, and the fleecy, milky cap.

Spores shed from July to November; landing on damp ground in coniferous woodlands, may germinate to develop a subterranean plant body that eventually will bear new fruiting bodies. Fruiting bodies not commonly clustered in great numbers as is common with those mushrooms that may be found on stumps or on woody plants.

Food evidently associated with evergreen woods. While this species and some others are edible, a number of species are not, and some are poisonous. Stem frosted or covered with bloom at first, spotted with orange and turning green where touched in this species.

Some consider this species a favored mushroom but others disagree. Since there are dangerous or inedible species in the genus, it is safer to avoid eating any of the milky-juiced mushrooms unless more exhaustive data than are here given are available to make sure of identification.

Pungent Russula
Russula emetica

Fruiting body umbrella-like, with cap to 3 in. broad, sunken in center, sticky when moist, smooth, brittle, with skin peeling easily to show faint reddish flesh. Cap red, but paler with age. Gills not crowded, some may be forked near stem, which is to 3 in. long and to ¾ in. thick, solid or pithy but fragile. Much of flesh is white. White-spored.

Resembles *Lactarius* but lacking its milky or colored juice when broken and being, like it, ordinarily rather brittle. Few russulas "bleed" slightly and, if anything, caps of russulas are more brittle than those of *Lactarius* due in part to the bunching of tissues, a character not visible without a microscope. Many russulas are edible, but a few are disagreeable and this one is reported by some to be poisonous.

Fruiting bodies appear from July to October, from the plant body hidden in rotten logs or in the forest floor. This species is not common in the open, and some russulas favor pines and spruces, while some grow in sand and some are at their best in open hardwood forests.

Species name *emetica* implies that this plant may serve as an emetic. Certainly, it has a strong and distinctive taste, but there are large numbers of persons who eat it regularly and enjoy it, although some books label it as poisonous. Some go so far as to say that there are no poisonous russulas.

Economic importance is small, and since fruits usually do not appear in great numbers at given place, they are not likely to appear in a mess of mushrooms unless mixed with others. For this reason, it is possible that they have been considered dangerous because of their strong taste and because they may be mixed with dangerous plants.

Canterelle
Cantharellus cibarius

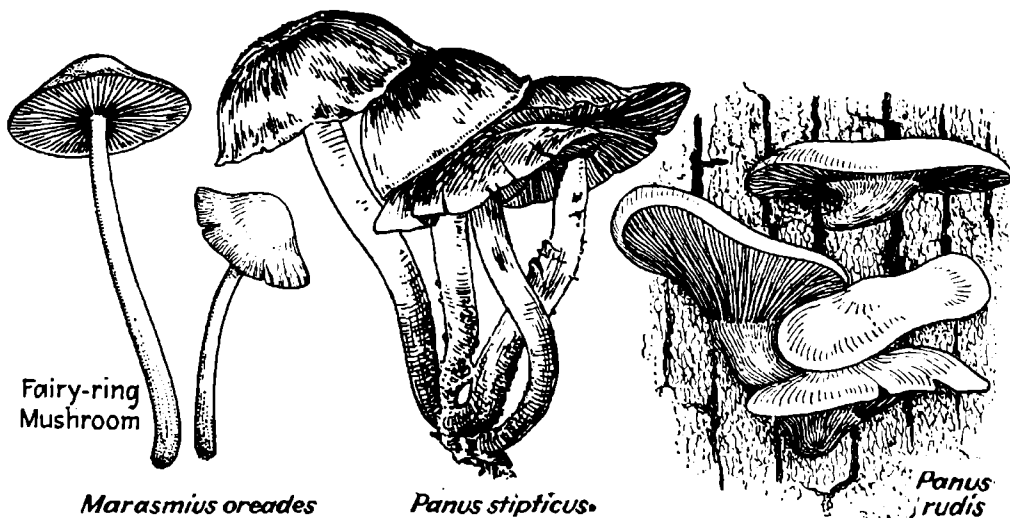
Fruiting body like wavy-margined cup, only slightly depressed in center and with rather coarse, uncrowded gills extending down stem from beneath cap. Cap to 3 in. across, fleshy, smooth, firm, like yellow of an egg. Stem to 2 in. long, solid, flexible. Whole plant fragrantly scented.

Blunt-edged gills extend down onto stem distinguishing this genus from other white-spored fungi. Three common species include orange-yellow *C. aurantiacus* of doubtful food value, the vermilion-red *C. cinnabarinus*, and this species, both of which are edible. Color usually sufficient identification for these, though gills of *C. cibarius* are fewer branched and more decurrent than in *C. aurantiacus*.

In July and August, fruit bodies appear singly or scattered in groups on ground, usually in coniferous woodlands or in hardwood forests. *C. aurantiacus* grows in abundance from rotten wood, probably saprophytic. While this is classed as a white-spored mushroom, spores are faintly yellow and elliptical.

Orange-yellow canterelle is found from July to September; the yellow, from July through August; and the red from July through October. Yellow is particularly well-known and favored in Europe as well as in the United States and Canada.

Fragrance and nutty taste as well as abundance of canterelle has made it famous and popular world over but more particularly in days of ancient Rome. To some, nutty flavor is somewhat bitter; and by some, orange-yellow species is considered as poisonous.



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales. Family Agaricaceae

Fairy-ring Mushroom
Marasmius oreades

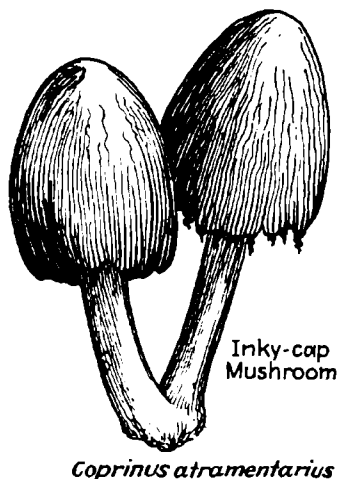
Cap to 3 in. across, tan or ivory, smooth, with rounded raised center, somewhat leathery in dry weather but reviving when wet, easily separating from the slender, tough to 4-in. stem. Flesh firm and white. *Collybia*, otherwise much like it, will not revive when wilted. Found usually in rings in grassy fields or on lawns or orchards from spring to fall and from year to year. Ring caused by exhaustion of available food from center. Dried, sliced, and then cooked in soups are delicious.

Panus
Panus stipticus

Leathery caps, with lateral stem or no stem, with gills entire, and with an acute edge. In this species, plant is cinnamon in color, most unpleasant to taste, and poisonous. Like *Marasmius*, this species will revive after it has been wilted by drying. It appears abundantly on old logs and stumps from early fall to winter and plant body buried in wood is phosphorescent and glows in the dark. Applied to a wound it contracts blood vessels and stops bleeding, styptic.

Panus
Panus rudis

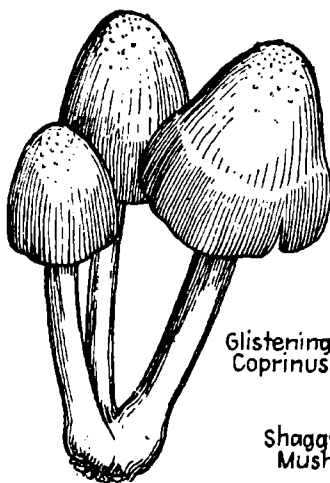
Cap an extension of stem, covered with a fuzz that is thick and reddish but faded with age. Gills pale tan, extend down onto stem almost to its base. Cap usually not over 2 in. across but caps are usually crowded in considerable numbers and a mass may sometimes nearly cover exposed part of a tree trunk or log. Plant leathery, attacked rather freely by beetles, not injured by drying, and in spite of toughness, may make good soup or gravy flavoring.



Coprinus atramentarius

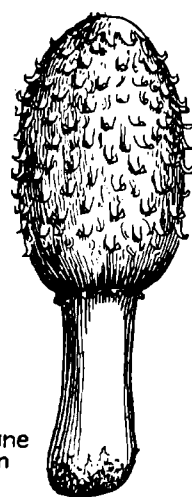
Inky-cap Mushroom
Coprinus atramentarius

Cap egg-shaped at first, smooth except for a few spotty scales in center, gray-brown or yellowish but black when mature. Gills closely crowded when young and break down into an inky fluid when mature. Stem slender, smooth, hollow, whitish, with a temporary ring, to 4 in. long. It occurs on ground, in clumps, in woods, or in open as on lawns, from late summer through fall. If cooked immediately after harvesting, it is excellent or can be made into a catsup that is delicious. No poisonous *Coprinus* species.



Glistening Coprinus
Coprinus micaceus

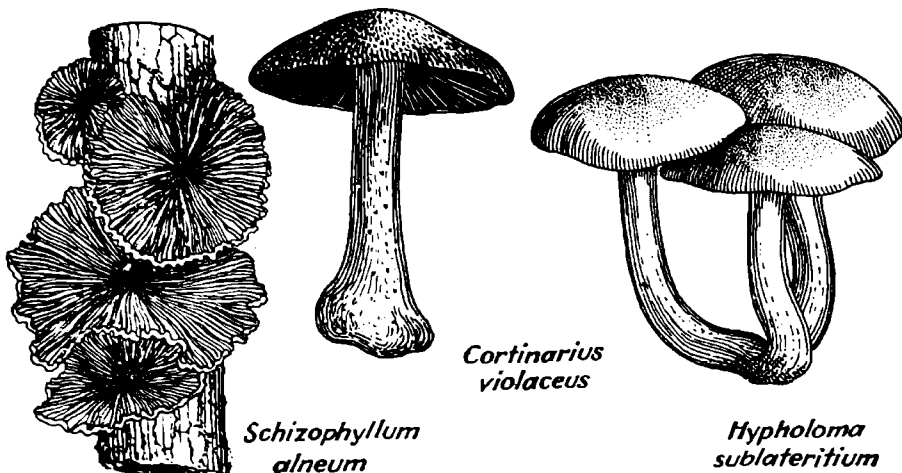
Caps much like those of inky cap; but are smaller and when young, are covered with glistening mica-like scales, are bell-shaped and definitely striated; tawny yellow, brownish yellow, or gray when young but become dirty in appearance and finally black when the crowded gills break down into a black ink and shed the spores. Stem smooth, slender, fragile, to 3 in. long and cap to 2 in. broad. Occurs in great numbers from stumps of old trees on lawns or in fields. Delicious when promptly and properly cooked.



Shaggy-mane Mushroom

Shaggy-mane Mushroom
Coprinus comatus

Cap at first oblong to cylindrical, whitish, with scattered yellow scales but splits at margin, flattens, and becomes shaggy, to 3 in. long before it expands. Gills white, closely crowded, turn pink, red, purple, and finally black dissolving into a dripping ink. Stem smooth, hollow, long and when young with a ring; to 5 in. long and to 1/2 in. through. Found in meadows and on lawns but not crowded. Excellent as food if taken when young or used as flavoring when older.



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES
Order Hymeniales. Family Agaricaceae

Schizophyllum
Schizophyllum alneum

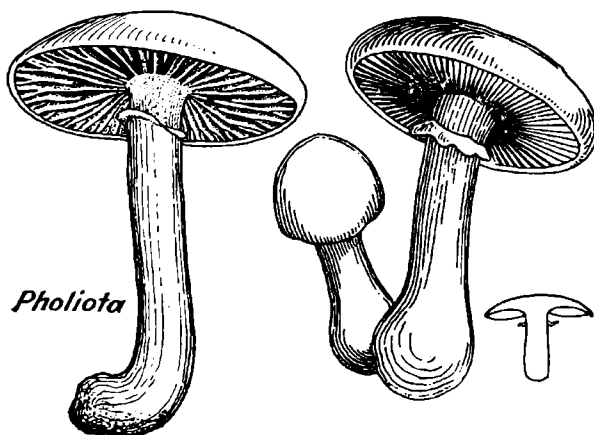
Dry, corky, fan-like shelves, with gills that are split at the edges and appear to be double, to 1½ in. across, with a downy surface; shrivels when dry and recovers when moist; without a stem and with white spores; may appear gray, then a purplish-brown, and then even white. Found commonly growing on old wood such as twigs and branches, particularly on maple, but may be found at any time of year and in most parts of the world. Hardly a parasite, since it serves to destroy waste.

Cortinarius
Cortinarius violaceus

Cap nearly flat, after being convex in youth; dark violet, covered with numerous tufts of hairy scales, to 4 in. across, with violet flesh and with a cobwebby interior that is distinct from skin of cap. Gills powdery with spores but become rusty with age, attached to stem and notched at stem end. Stem swollen at base, to 5 in. long, solid. Found for most part in woods in late summer or early fall, scattered or solitary. Edible but not exceptionally popular.

Hypholoma
Hypholoma sublateritium

Cap continuous with stem, brick-red but often paler at margin, convex or flat, smooth, with white or yellow flesh, to 3 in. across, with a veil that remains attached to margin of cap but with no ring. Stem smooth, fibrous, to 3½ in. long, rusty, tapering to base. Found often in large clusters around old stumps with many stems arising from a common point, from September through to winter. Considered as edible fungus but is usually insect-fouled and bitter.

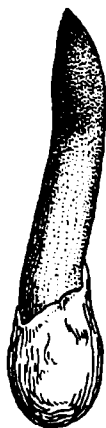


Pholiota
Pholiota praecox

Cap is umbrella-shaped, to 2 in. across, convex or plane, slightly sticky when moist, white or pale tan, with incurved margin. Gills are crowded, unequal, widest at center, from dirty white or gray to rusty. Stem is to 3 in. long and to ¼ in. through, spongy inside or hollow. Found on lawns, in meadows, and along roadsides from May to June, while related fatty pholiota *P. adiposa* is found on tree trunks from September through frost. A mass of early pholiota may weigh a pound and make a family's meal.

Meadow Mushroom
Agaricus campestris

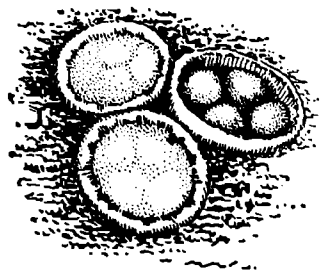
Cap to 4 in. across, hemispherical, then convex, then expanded, soft, satiny white, with much incurved margin at first. Gills free from stem, thin, crowded, white, then pink, then blackish-brown. Stem to 3 in. long and to ¾ in. through, with ring usually persistent. Flesh thick, firm, white, with good flavor and scent. Cap and stem easily separate but cap leaves a ring. May resemble some poisonous lepiotas. Among species of this genus are the horse mushroom, the flat-top, the sylvan, the reddish-brown, and others. Commercial plantations are established in cellars and tunnels where hocks of plant body "spawn" are planted in manure and rich soil and maintained at 50-60°F. Commercial mushrooms should develop in less than 10 weeks after beds are established if properly managed and soil, temperature, and humidity are satisfactory. Yield in summer is usually small but in fall large. Minor spore differences are recognized between commercial and wild forms. This species is probably eaten more than any other fungus though not so important as yeasts, rusts, smuts, and the like.



Mutinus caninus

Dictyophora duplicata

Stink-horn



Bird's-nest Fungus

Crucibulum vulgare

DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI. CLASS BASIDIOMYCETES

Order Phallales
Family Phallaceae

Order Nidulariales
Family Nidulariaceae

Mutinus

Mutinus caninus

Like a slender pointed cylinder, with a red-tipped or a flesh-colored tipped end. Apparently comes from a small egg the skin of which remains attached around the base. The erect cylinder is definitely spongy and looks something like soft flesh. Saprophytic, living on dead plant matter and is therefore of no serious importance. Found in damp thickets, woodlands, old gardens, usually in July and August. Fruiting body does not last long.

Stink-horn Fungus

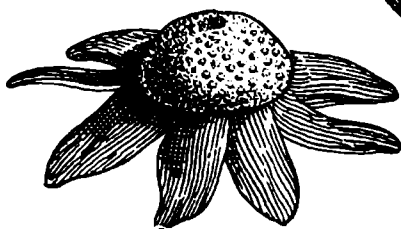
Dictyophora duplicata

A beautiful but horribly foul-smelling plant appearing like a large egg that produces a pitted cylindrical stem that is to 9 in. long and to 2 in. in diameter, crowned by a slightly larger, more pitted cap from which hangs an open lacework structure that supports a free ring. Found more or less singly in open meadows and grasslands but more particularly around old sawdust piles in summer and fall. Apparently of no economic importance and too offensive in odor to be popular.

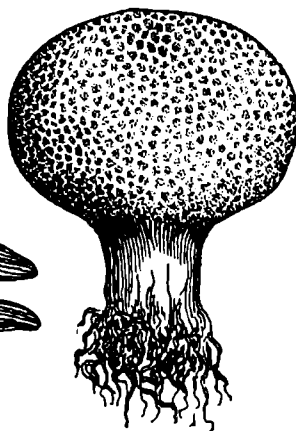
Bird's-nest Fungus

Crucibulum vulgare

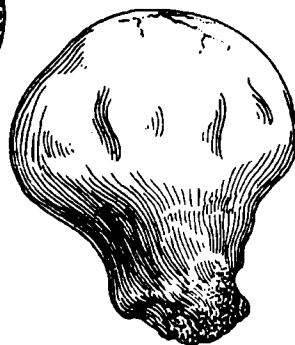
Like minute birds' nests that are about $\frac{3}{4}$ in. across, at first covered by a thin membrane that breaks, revealing the "eggs" nestling in the shallow, yellowish nest. So-called "eggs" rupture to free reproductive cells. Found sometimes in great profusion on old sticks, wooden bridges, fence rails, and other unused wood. Undoubtedly saprophytic and of no serious destructive properties. The related family Sphaerobolaceae produces but one egg per fruit body instead of many.



Earth-star



Common
Scleroderma



Lilac Puffball

Order Lycoperdales. Family Lycoperdaceae

Earth Star

Geaster sp.

Looks like a sphere with an opening at top from which spores are freed and supported by a star-shaped base that may vary its position considerably in accordance with weather. It opens in dry weather, raising plant from ground, and closes in wet weather, bringing spore-bearing sphere again close to ground. Found on the ground in woodlands or in open grassy territory. It apparently is of no great economic importance though interesting.

Common Scleroderma

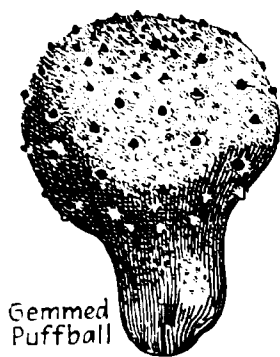
Scleroderma sp.

Look like hard-skinned, scabby spheres or at least somewhat spherical, with a firm greenish-yellow interior that shows when broken. In some species the exterior is orange but in most it is a greenish or a yellowish-brown or dark brown. It is found commonly in pastures and meadows particularly where the soil is poor, generally from August on through November. Usually, these fungi do not exceed 3 in. in diameter. Not poisonous but not good as food.

Lilac Puffball

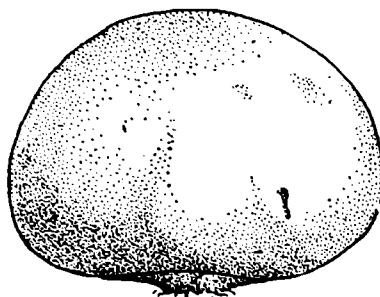
Lycoperdon cyathiforme

Like slightly flattened globes that are to 6 in. in diameter, whitish, pinkish, then brown, and in the upper areas cracking and freeing the dark brown to purple spores. When old, the fruiting bodies appear to be scooped-out cups. It is sometimes called the beaker-shaped puffball because of the stout stem that supports the expanded beaker-shaped upper part. When young, the fruiting bodies are white both on the outside and inside. They are edible when young and excellent.



Gemmed Puffball

Lycoperdon gemmatum



Giant Puffball

Bean Anthracnose



DIVISION I. THALLOPHYTA. SUBDIVISION II. FUNGI
CLASS BASIDIOMYCETES
Order Lycoperdales. Family Lycoperdaceae

Gemmed Puffball
Lycoperdon gemmatum

Top-shaped spheres that are to 3 in. high and to 2 in. wide, with a relatively stout stem that penetrates the ground and may be longer than the ball above the ground is through. When young, balls are warty on outside and surface changes from fine-scaled to fuzzy, to warty, to smooth.

Relationships are discussed more fully in next column. Most of interior of all members of this genus at maturity breaks down into masses of light spores. Some species differences based on the way outer walls break to free these spores. In some, whole wall seems to crumble into bits while in others breaks are along more or less definite lines.

In addition to details given for *Lycoperdon* p. 68), it should be pointed out that in this plant there is a tremendous loss in reproductive process and an infinitely small proportion of spores ever develop into plants that themselves bear spores. This is true of most of fungi, of course, but more obvious with dark-spored forms.

These puffballs have been recommended for use as quenchers for flow of blood. It is doubtful if they have any merit in this connection though some fungi do have styptic properties, as has already been pointed out. Probably they would do little damage if used on a wound.

While this species is edible when young, it lacks the agreeable flavor of the giant puffball. Like other puffballs, it should be eaten only when flesh is firm and white. The cooking procedure is the same as that outlined for the giant puffball.

Giant Puffball
Calvatia giganteum

White or whitish balls, when young, varying in size from one to a few inches through in *Lycoperdon* to a maximum of 5 ft. high and 4 ft. wide in *Calvatia*, and in shape from spheres, to somewhat elongated vases, to depressed spheres with surfaces smooth or otherwise. Fruiting bodies above ground.

Related *Scleroderma* has underground fruit bodies thick-walled and with black or purple interior. Lycoperdales includes all true puffballs and earthstars. *Calvatia*, the giant puffball, breaks the fruit body wall irregularly. Some, with papery walls, are classified under genus *Bovista*. Related earthstar *Geaster* breaks fruit body to form a many-pointed star that opens and closes in dry and wet weather.

Lycoperdon species usually rupture more or less papery fruit body to free airborne spores through definite area at top. Spores wind-borne. Fruit bodies white throughout at first, but later black. A 5 lb. 3 oz. puffball yields about 7 trillion spores; if each matured, second generation would be 800 times the size of the earth.

Plants are saprophytes living on decaying plant material either in open grassy fields, in wooded areas, or in cultivated lands. One species, *L. gemmatum*, is often found in considerable numbers on well-rotted logs, though pear-shaped *L. pyriforme* is even more partial to old wood.

All puffballs with white interiors and fruit bodies above ground are edible and some are delicious. Larger *calvatias* may make many meals for a family. Fruits may be sliced, parboiled in salt water, and fried in butter or in hot fat to make a delicious dish. Should be eaten only when collected white.

Bean Anthracnose
Colletotrichum sp.

Bean anthracnose appears as brownish or purplish, usually sunken spots that later develop into extensive patches. These infect the seeds that in turn infect the succeeding crop. The disease appears on the seed leaves, on the stems, and on the seeds and fruits of beans.

The imperfect fungi to which this plant belongs have life histories that are somewhat in doubt since they lack some of the properties that would place them in one or the other of the major groups that are recognized. Some seem to have relationships with the basidiomycetes and some with the ascomycetes and some may have had or lost the characteristics which would readily classify them with one or the other.

A few imperfect fungi cannot be classified because they seem to exist only as sterile mycelium without normal reproductive bodies one would expect in fungi. Others have merely what seem to be asexual stages of a fungus, but in spite of these shortcomings most of these fungi seem to be able to maintain themselves in too great vigor.

While many imperfect fungi are saprophytic, living on dead plant material, some are parasitic and may be serious pests as is the bean anthracnose here figured. They form cankers on limbs and branches of trees, spots and rots on fruits, and a number of other unfortunate deformities and injuries.

Bean anthracnose is controlled by selection of resistant varieties, by selection of seeds from clean pods, by burning old infected plants, and by spraying with bordeaux, 5-5-50, particularly when disease occurs early and has not made too much progress before being discovered.

DIVISION II. BRYOPHYTA

While the bryophytes, including the liverworts and mosses, are one of the small divisions of plants, they are not the smallest. Of some 240,000 described species of plants, about 17,000 are in this division; only 4,500 are in the pteridophytes, which include the ferns.

In the life histories of all plants there are two essential stages, a *gametophytic* stage that bears true sex cells and a *sporophytic* stage that either follows or precedes this and bears asexual reproductive organs. However, asexual spores may be borne by the gametophytic stage. In the thallophytes, which include the algae and fungi, the gametophytic stage is the obvious one. In the pteridophytes and spermatophytes, the sporophytic stage is what we see most easily. In the bryophytes, we can usually see both with the naked eye if we know when and where to look. In a common moss, for example, the main part of the plant is gametophytic while the stalk and little capsule that produces the spores form the sporophyte. Specialists in this group of plants are known as bryologists.

Two classes of bryophytes are recognized, each with three orders. We here consider two orders in each of these two classes. In all these bryophytes there is no such development of roots, stems, and leaves in the sporophytic stage such as we find in the pteridophytes and spermatophytes. A simple, relatively safe distinction between the mosses and liverworts is that in the mosses the conspicuous plant body is usually radially symmetric while in the liverworts this is not so.

Class I. Hepaticae. The Liverworts.	pp. 71-72
Order 1. Marchantiales. Thallose liverworts	p. 71
Order 2. Jungermanniales. Leafy liverworts.	pp. 71-72
Class II. Musci. The Mosses.	pp. 73-75
Order 1. Sphagnales. Peat-bog mosses.	p. 73
Order 2. Bryales. True mosses	pp. 73-75

DIVISION III. PTERIDOPHYTA

Probably the smallest of the major groups of plants is the division Pteridophyta. It includes only some 4,500 species represented by the ferns, club mosses, horsetails, and quillworts. Probably because this group is small, it has attracted many naturalists, who find that with relatively little effort they can become acquainted with all members of the group to be found in their vicinity.

In the more primitive groups of plants already considered, the conspicuous part of the plant has been the part that bears true sex cells, or the gametophyte. In the ferns and other pteridophytes, as well as in the flowering plants, the conspicuous part of the plant is the sporophytic stage, which does not produce the sex cells directly. In some pteridophytes the gametophyte is relatively easy to find, but in many others it is almost impossible to locate. In the typical fern the gametophyte may be a small, flat, green structure. Some of these are easy to culture by merely sprinkling fern spores on a moist surface and maintaining humid surroundings in which development may take place.

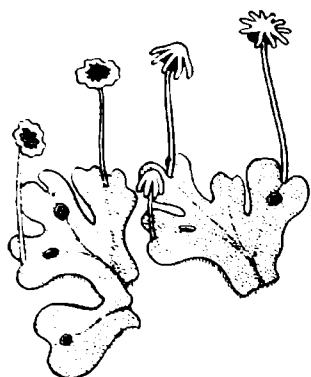
While the pteridophytes are now relatively few and inconspicuous in the average environment, there was a time during the Carboniferous period of the Paleozoic age when they represented the highest development of plants on the earth. Then they attained sizes comparable to our present forest trees. Their preserved remains form the basis for much of the coal that today keeps the wheels of industry turning. Today pteridophytes grow in deserts or submerged in water or in intermediate types of environment. There are few places on the earth where some pteridophyte cannot be found. The sporophyte stage of the pteridophytes possesses true root and stem tissue. Some of our modern pteridophytes that grow in the tropics still reach a height of 40 ft. or more. Many of the known groups of pteridophytes are today represented only by fossil remains. Local living representatives are frequently treated well in state publications. Iowa, Tennessee, Michigan and other states have issued good popular bulletins on their pteridophytes.

In this book, we present introductions to representatives of three of the usually recognized seven orders. Two of the seven are now extinct.

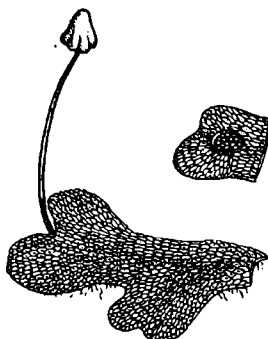
Most of our ferns belong to the order Filicales, pp. 76-83.

Common club mosses belonging to the order Lycopodiales are presented on pp. 84-85. In this group are included the quillworts.

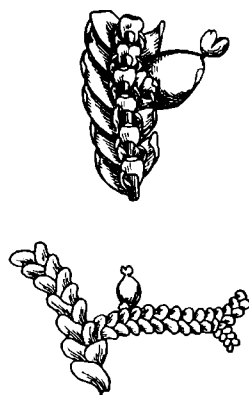
The horsetails or scouring rushes are today represented by only one genus, of which two species are presented on p. 84.



Marchantia polymorpha



Conocephalum



Scale-moss Liverwort†
Porella platyphylloides

DIVISION II. BRYOPHYTA. CLASS I. HEPATICAE. LIVERWORTS
Order Marchantiales Order Jungermanniales
Family Marchantiaceae Family Porellaceae

Marchantia
Marchantia polymorpha

Dull green, forked ribbons, to 5 in. or more long, with prominently sunken midribs above, with upper surface marked off in diamond-shaped areas each with an oval or circular dot in the center. On close examination, the diamond areas are really 8-sided and the pores are air holes leading to the interior. Underside of thallus crowded with root-like structures.

A liverwort of the family Marchantiaceae, which includes *Lunularia* of greenhouses, *Conocephalum*, and *Preissia*. *Marchantia* is found all over North America and Europe with this species most common in the North and with two other closely related species in the South.

Thallus is either male or female. Male thallus bears erect, flat-topped structures that bear the antheridia that produce the spores that make their way by swimming to the female structures. Male structures are antheridiophores. Female plants bear umbrella-like archegoniophores beneath branches of which are the eggs that produce the yellow sporophytes. Asexual reproduction.

Plant usually most abundant on newly disturbed clayey or silt-filled soil particularly in burned areas. May thrive in crevices between stone flagging. Umbrella-like structures develop even though eggs are not fertilized and reach maturity through June to August. Spores are forced from the capsules of the sporophytes by spring-like structures.

Plants are of little economic importance but are most commonly used for illustrating development in the bryophytes in classes in biology. Plants lend themselves readily to culture in terrariums. May serve some purpose as soil anchors in areas where other plants could not survive.

Conocephalum
Conocephalum conicum

Largest of our liverworts with broad flat thalluses, in this case often covering many square feet of surface. Plant body is paler green than is *Marchantia*, with marked areas on the upper surface, larger and more distinctly defined, these often being sufficiently large to be recognized many feet away. When the thallus is broken, it gives off a strongly resinous odor.

A liverwort further distinguished from *Marchantia* by the fact that the air pore in each surface segment is borne on top of a low mound of colorless cells. Like *Marchantia*, *Conocephalum* is found widely distributed over North America and Europe.

Male sperm-bearing antheridia are borne in a wart-like spot on the thallus rather than on a tall flat-topped antheridiophore as in *Marchantia*. The female archegoniophore looks like a partly-closed umbrella with a long handle. It is watery and does not last long. It usually matures somewhat earlier than does *Marchantia*. Asexual spores are borne in remarkably shallow cups.

Found for the most part on moist earth or on the dripping rocks of gorges and glens, often entirely covering considerable areas to the practical exclusion of other plants. Do not expect to find the spore-producing umbrellas in late summer when *Marchantia* may be in excellent fruiting condition.

Probably of little economic importance though it was once thought to have some medicinal properties. It must serve to some extent to anchor soil as well as to add organic material to small patches of soil that must be more or less sterile.

Scale-moss Liverwort
Porella platyphylloides

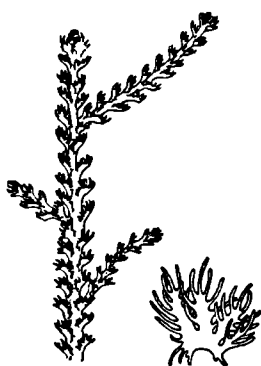
Stems to over 3 in. long, branched, prostrate, slender, and hidden by the closely overlapping thin leaves each of which is blunt at the tip, to nearly $\frac{1}{2}$ in. long, but the whole plant with its many branches covering an area sometimes many square feet in extent. Beneath the closely overlapping leaves are underlobes and underleaves that hug the stems.

While *Marchantia* and *Conocephalum* belong to the order Marchantiales or thalloid liverworts, *Porella* belongs to the leafy liverworts of the order Jungermanniales. Two species of the genus are recognized but are difficult to distinguish one from the other. They are widespread in North America and Europe.

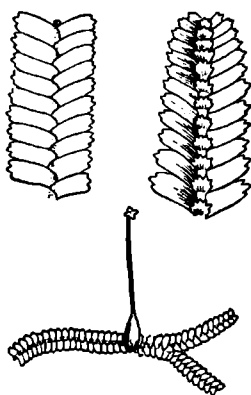
Male and female reproductive organs are borne in separate structures on separate plants so that a plant is either male or female. They appear as small buds on the branches and the fruits look like little cups that mature to free the spores in May or June. They are not conspicuous in comparison with the developments to be seen in *Marchantia*.

P. platyphylloides usually lies flat on bark of living trees though the tips may be raised. *P. pinnata* is attached to rocks and is generally submerged. *P. navicularis* is conspicuously glossy, is found on our northwest coast on trees and logs; and *P. curdasana* and *P. roellii* are also native of the northwest areas.

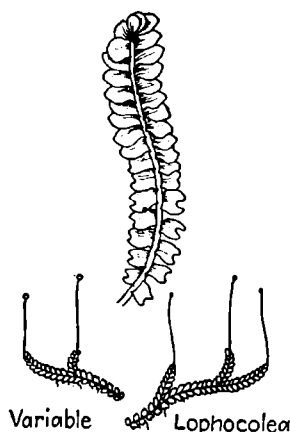
Plants are of little importance economically and are of interest to botanists who find in them interesting variations in reproductive habits as well as in branching and leafing habits.



Scale-moss Liverwort



Three-toothed Bazzania



Variable Lophocolea

DIVISION II. BRYOPHYTA. CLASS I. HEPATICAE. LIVERWORTS
Order Jungermanniales. Family Jungermanniaceae

Scale-moss Liverwort
Ptilidium pulchrinum

Leaves without any midrib, in 2 rows near upper side of the stem, deeply divided into fine lace of threads or rows of cells, but with these joined into a substantial base that is from 6-20 cells wide as contrasted with narrower leaved genera, often somewhat purplish-brown in general color, to $\frac{1}{8}$ in. wide with the leaves spreading when moist and close-pressed when dry.

Leafy liverwort belonging to the order Jungermanniales and the family Jungermanniaceae. In this country, the genus is represented by this species and the wider-leaved *P. ciliare*, both of which are circumpolar and extend in America south to Pennsylvania and Illinois, and by *P. californicum*, which ranges on the West Coast from Alaska to California and Idaho.

From the axils of the branches there frequently appear what seem to be white "hairs." At the tips of these are small black capsules in which the spores ripen and are ready to be shed in the spring. The capsule may persist on the plant after the spores have been shed, and the supporting hairs after the capsules have been shed.

Plants are most conspicuous in early spring when they appear most commonly on rotted wood or on tree trunks. They are frequently found mixed in with mosses. Usually, the botanists who are interested in these liverworts use the leaves as a basis for distinguishing the species, the important characters being the number of lobes and the number of hair-tipped lobe divisions.

Plant is probably of no economic importance whatever, but it does appear as an attractive decoration for a tree trunk or a fallen log.

Three-toothed Bazzania
Bazzania trilobata

Stem branching, prostrate, and closely crowded with overlapping leaves that seem to form a continuous frill to either side. May form a solid patch to 2 ft. across. Leaves are 3-toothed at the tip, bent toward the ground when they are dry, are firm and green or brown. Leaf and branch are to $\frac{1}{8}$ in. wide and individual branches are rarely over 5 in. long.

A leafy liverwort of the order Jungermanniales and the family Jungermanniaceae. It is found east of the 95th meridian and in Europe. In Washington State it is represented by *Bazzania tricerenata*; five other species are recorded as being found in North America.

Rarely found in a fruiting condition. Sex organs appear as buds from the sides of the branches. Male organ is a leafy structure while the female is a stalked capsule, or rather produces a stalked capsule that usually reaches maturity sometime late in the summer. One of these plants in fruit is a find many botanists never make.

Found usually on moist shaded logs or rocks; while they usually cling close to the supporting surface through most of their length, they may turn upward at the tips. Structures that appear to be rootlets are borne at intervals along the undersides of the trailing stems. The plant may be found in woodlands or in marshes but is essentially a shade lover.

Not of any significant importance economically, and not commonly recognized by botanists except by specialists in the group. Most introductory botany texts may mention the order and may figure one of the plants, but they rarely do more than this.

Variable Lophocolea
Lophocolea heterophylla

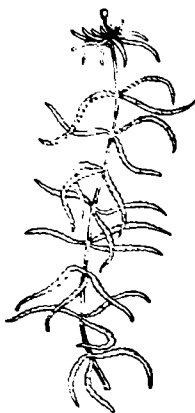
Stems trailing, slender, with root-like structures beneath. Leaves bright green if growing in exposed sunlight. Underleaves small and inconspicuous. Upper leaves some entire and others deeply 2-toothed, hence the name *heterophylla*. In the related *L. bidentata*, the leaves are broadest at base and with 2 long pointed lobes.

A leafy liverwort of the order Jungermanniales and family Jungermanniaceae. This species common over wide areas in the United States, southern Canada, and Europe. Closely related *L. minor* is about half the size of this species. *L. bidentata* and *L. cuspidata* are found in much the same range.

In *L. heterophylla*, sex organs are borne close to the stem, the female looking like a leafy bud that produces a body bearing a small egg-shaped capsule that sheds spores in May. Sex organs mature in autumn but the sporophytes do not appear in nature until spring, though they may develop in January in the laboratory. *L. bidentata* has male and female organs on separate plants.

Common for the most part on shady banks, on rotten wood or sometimes exposed to strong sunlight. This is the general habitat of most species of the genus. In both *L. bidentata* and *L. cuspidata*, the leaves are broad-based and divided into 2 long, pointed lobes.

Not of any recognized economic importance. Attractive when well-developed but serves little purpose and does little if any injury to anything.



Acute-leaved Sphagnum



Boat-leaved Sphagnum



Purple Horn-tooth Moss

DIVISION II. BRYOPHYTA. CLASS II. MUSCI. MOSSES

Order Sphagnales

Family Sphagnaceae

Acute-leaved Sphagnum

Sphagnum capillaceum

Stems weak, crowded, and forming often a pure stand. Stems are clothed with 2-3 layers of empty cells that lack the spiral markings of *S. palustre* and its associates. Branches or branchlets taper to a fine point and may be distinctly purplish, though they may also be red or green. Lower portion of the stem is of course decayed.

A peat moss of the family Sphagnaceae and the order Sphagnales with general characters as already mentioned. There are 10 species in North America closely related to *S. capillaceum* and about 20 similar to the related *S. cuspidatum* that has long narrow branch leaves that are spreading and wavy-margined when dry.

Male organs in this species are usually on red branches, while the female organs are on tassel-like branches. The two may be on the same or on separate plants. The stalk of the spore case is of gametophytic origin as is true of the other peat mosses. The spore cases in this species are spherical and the spores are distinctly rusty.

Associated with these plants are the sundews, pitcher plants, cranberry, cotton grass, a number of our most beautiful orchids, bog rosemary, Labrador tea, cassandra, and other interesting plants. Most of these are uniquely equipped to use a minimum of water from beneath though their lower portions are almost always submerged.

This is a bog builder. It is used also in the making of absorbent bandages for use in medicine or for packaging trees and other plants to be shipped in marketing. Dried, living or dead portions may be used as fuel and in some parts of the world are the main source of fuel. They are also used in gardens to cut down weed competition.

Boat-leaved Sphagnum

Sphagnum palustre

Stems weak but crowded compactly together to form great mats, sometimes acres in extent, with the upper foot living and the lower portion in varying degrees of decay. Erect stems are covered with leaves as are the branches, the leaves being broad, spoon- or boat-shaped, with the tips turned back from the stem. Spiral lines on walls of stem scales.

In North America there are 6 species of *Sphagnum* with the walls of stem scales marked with spiral lines. The plants belong to the family Sphagnaceae of the order Sphagnales, in which the spore cases open by a circular lid with the opening unguarded by teeth. In this species the branchlets are stout and in large heads not slender pointed.

Male and female organs in this species are on separate plants, the male plants being thick, coarse, and yellow, brown, green, or red. The spores are borne in a capsule at the end of a stalk that is gametophyte rather than sporophyte, thus differing from the true mosses and being like the other peat mosses.

Plant is one of the common bog builders. It can take water from the atmosphere by means of the absorbent cells on the branchlets and stems and thus is independent of water from beneath. In bogs and places where this moss grows, the water may be abundant but may also be physiologically useless.

Plants are used as fuel either from recent plants or from the peat they produce. They are also used as absorbent materials in surgery, or for holding water in packing around trees and other living plants in the process of being marketed. Peat is built by these plants at the rate of about 1 ft. in 100 years.

Purple Horn-tooth Moss

Ceratodon purpureus

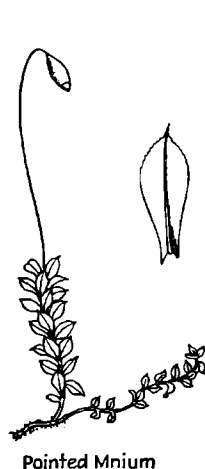
Stems rarely over 3 in. long, erect, densely crowded, branching, leafy. Leaves lance-like, keeled, with irregular margins, with tips commonly somewhat curved backward, bright green in winter but purplish in summer and fall, with margins curled, very narrow and, when dry, very wrinkled, sometimes distinctly reddish-brown.

One of the commonest of the true mosses, particularly in places that become very dry as on roofs, dry walls, at edges of flagging, or on dry lawns. This is the common species of the genus. Closely related genus *Ditrichum* has smooth, erect capsule while this one has ridged and more horizontal capsule.

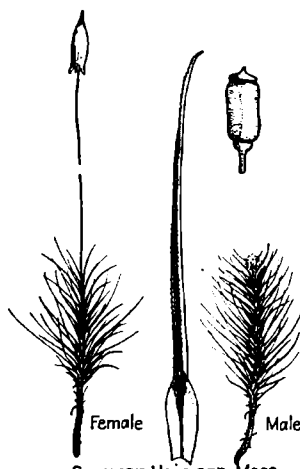
Male and female organs borne on separate plants. From the fertilized egg arises the sporophyte with a stalk almost as long as the stem of the plant, slender and usually conspicuously glossy. Capsule at the end of stalk is dark chestnut or reddish-brown, furrowed and held in an almost horizontal position at an angle with the stalk.

The change in color of these plants from bright green in winter or early spring through brown to purple in summer and fall is rather spectacular. While the soil or surface on which the moss grows may be genuinely dry for a major portion of the year, it must be moistened occasionally if the plant is to survive.

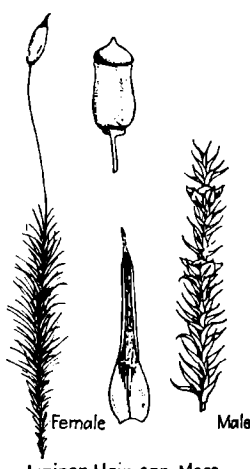
Of little or no economic importance unless it may be considered as a soil maker or anchor. It may serve crudely as an indicator of humidity by the position of the leaves. It is at its best in early spring and does little during the summer months.



Pointed Mnium



Female Male
Common Hair-cap Moss



Female Male
Juniper Hair-cap Moss

DIVISION II. BRYOPHYTA. CLASS II. MUSCI. MOSSES

Order Bryales

Family Mniaceae

Pointed Mnium *Mnium cuspidatum*

Stems and young leaves bright green, becoming much darker with age. Leaves toothed slightly along the margin of the upper half; the midrib continues to form a prominent tip. Leaves near the top of each branch, definitely larger than those lower down. Plants from $\frac{3}{4}$ to $1\frac{1}{2}$ in. high.

Common particularly in the central and eastern parts of the United States. In the northwest, *M. venustum* with all stems erect and a necked capsule is common while *M. medium* with large leaf cells is found in Europe, across North America, and to the north.

Male and female elements borne in the same cluster. From the fertilized egg develops the sporophyte with its slender, pale stalk, from the end of which droops the neckless capsule from which the spores are freed in spring. In this species, the sterile stems may bend over, root at the point of contact, and reproduce in this manner.

Favors ground that is well-shaded and not too dry, the plant being relatively delicate in comparison with some other mosses. It survives dryness by crisping the leaf margins, thus reducing the area exposed to drying. Related *M. venustum* does not reproduce with its sterile stems as outlined above for this species.

Of no obvious economic importance. It does come up for consideration rather commonly in classes in botany in college and high-school levels. It lends itself well to culture in terrariums and is popular in this connection. It may serve some purpose in soil making and in soil anchorage.

Common Hair-cap Moss *Polytrichum commune*

Stems to 1 ft. long, erect, crowded. Leaves crowded, to $\frac{3}{4}$ in. long, with enlarged, silvery, shining base, with margins toothed at least to the middle. In related *P. juniperinum* leaf margins are translucent and rolled over the upper leaf surface. Plants often form pure stands covering areas yards across.

P. commune and *P. juniperinum* have a general distribution over the Northern Hemisphere, with some related species rather limited. *P. piliferum* requires sand or rocks as a base for growing but is found from sea level on the Atlantic Coast to elevations of over 12,000 ft. in Colorado.

Male and female organs are borne on separate plants, the clusters bearing the male organs being terminal and swollen into a flower-like structure. Sporophyte consists of a 4-in. stalk bearing at the end a capsule which is almost cubical, and which at first is erect and then horizontal, capped by a blunt, short-tipped cap and a hood-like calyptra.

Common in woods or at edges of peat bogs or in other relatively infertile places, where they may form clear stands. They do not absorb water from the air as do the associated sphagnum mosses. The family is characterized by having from 32-64 teeth at the capsule mouth and a light membrane over the capsule mouth.

Of little economic importance though the plants have sometimes been used as a cheap stuffing for pillows and upholstery. They may serve some purpose as soil anchors, as holders of water, and as soil makers. The plants are commonly used for study in botany classes because of their size and abundance.

Family Polytrichaceae

Juniper Hair-cap Moss *Polytrichum juniperinum*

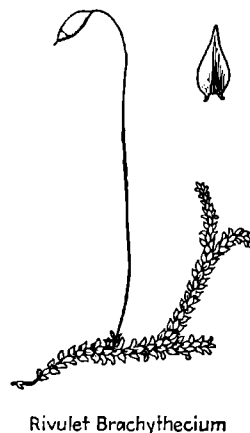
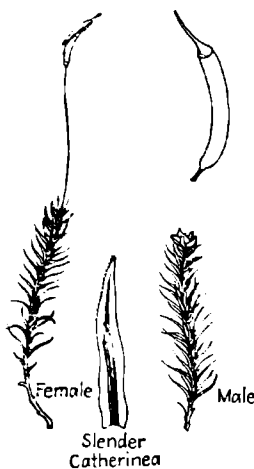
Conspicuous because of bluish-white bloom that covers the plant. Stems to 4 in. long. Leaves tipped with a red point that is obscurely saw-toothed, with enlarged, sheathing leaf base, but the main margins of the leaves are not notched as they are in the common hair-cap moss. Stem-tip often swollen.

Found in dry places where the sand or rocks are basically dry and usually not well occupied by other plants. This species is common all over the Northern Hemisphere. The related *P. piliferum* is found from sea level to the 12,500-ft. elevation in the Rockies, in full sun and where the rocks are largely silica.

Male and female sex organs borne on separate plants with male at least in conspicuous terminal leafy structures. From fertilized egg develops sporophyte with long red-brown stalks that may be $2\frac{1}{2}$ in. long with rather 4-angled, relatively short spore cases at tip. Spore case usually rather erect.

There are at least a half-dozen common species of this genus found widely distributed in North America and usually with rather conspicuous differences. In this species, a translucent leaf margin that rolls over the upper surface of the leaf is rather distinctive if the general bloom and other characters are not adequate.

Possibly of little direct economic importance though some species have been used as cheap stuffing for upholstery and the mats undoubtedly do serve to prevent rapid run-off of water from otherwise bare rocks, thus contributing to the prevention of soil erosion and floods.



DIVISION II. BRYOPHYTA. CLASS II. MUSCI. MOSSES

Order Bryales

Family Polytrichaceae

Slender Catherinea *Atrichum angustata*

Stems slender, a few inches tall at the most, well-covered with slender leaves. Leaves with midrib-like structure composed of 4-7 folds and covering half the leaf. Leaf bases do not sheathe the stem. Under a microscope, the tip margins are finely toothed for most of the upper half, curl conspicuously when dry.

Very common in the northeastern part of the United States particularly on half-shaded, hard, compact soil. Related *A. macmillani* is smaller and more dense. *A. undulatum* with its purple capsule is common in the Great Plains area and *A. crispum*, with smooth leaves, grows on peaty soil from New Jersey to British Columbia and Oregon.

Male and female organs borne on separate plants. Male rosettes are conspicuously bright red while the females are not conspicuously developed. The developed sporophyte is a dark-green or purple capsule, mostly cylindrical and curved, with a beaked lid and one-sided cap and borne on inch-long shining red stalks.

Most conspicuous from late autumn to early spring where patches of plant may stand out conspicuously on the ground in woods and along roadsides in North America, Europe, or Asia. It may form a sort of felt cover for otherwise naked stones.

Apparently of no recognized economic importance though it must make some contribution to the story of soil making and possibly to soil erosion. Plant is sometimes listed in literature as *Catherinea* rather than as *Atrichum*, a difference of opinion significant primarily to systematic bryologists.

Family Leskeaceae

Common Fern Moss *Thuidium delicatulum*

Stems loosely branched in a feather-like manner, the divisions often being subdivided. Plant appears to be loose, weak, sprawling, and somewhat fern-like. Stem leaves crowded, enlarged at the base. Branch leaves broadly oval, concave at base, long-pointed at tip, with toothed margins. Often forms mats several feet across.

Found from Labrador to British Columbia and south to the Gulf of Mexico. At best in moist shaded places. Closely related *T. recognition* is stiffer, more yellowish, with shorter, broader stem leaves. At least another half dozen common species are also referable to this genus, which belongs to the family Leskeaceae.

Leaves around the female sex organs bear long hairs along the upper margin. Fruits are usually not abundant, do not form readily, and do not appear normally until autumn. Capsule is borne on a long stout stalk and at maturity is conspicuously curved. Lid is conical and spores mature in midwinter. Cap is split up one side.

One of the prettiest and daintiest of mosses, found not only in North America but in South America and Europe as well. It may cover stones in flowing streams or be found on drier ground. It may also be found growing on the roots or trunks of trees.

Merely a beautiful little moss known sometimes as the dainty cedar moss and named *delicatulum* or "dainty" by the great botanist Linnaeus. Ordinarily, it is not a difficult moss to identify. Related *T. abietinum* is cylindrical when dry and with stems only once divided; *T. minutulum* appears chain-like when dry because of curved leaves.

Family Brachytheciaceae

Rivulet Brachythecium *Brachythecium rivulare*

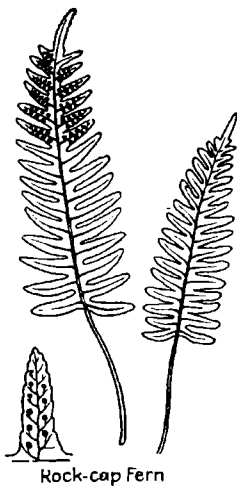
Large, light-green, leafy moss, with stems that are to 2 in. tall and variable, depending on whether the plant is submerged or growing in the air. Leaves rather widely separated in comparison with some close relatives, with the stem leaves larger than the branch leaves, concave, to 1½ mm. long, with obscure teeth.

Found commonly on wet rocks, in wet places, or submerged in still or in flowing water that is fresh. Found in Europe, and in North America in Canada and the United States from the Atlantic to the Pacific, south to Missouri and Virginia or North Carolina. At least 9 relatively common North American species.

Plants bear either male or female sex organs; after the sperms fertilize the eggs the sporophyte develops in autumn with long stalks capped by cylindrical spore case that is not beaked but rather broad and spindle-shaped. Spores are shed through the winter or well into it and from these develop a thread that eventually bears new stems.

This plant favors cool swift streams though it may be found elsewhere. The related *B. rutabulum* bears male and female sex organs on the same stem and forms large bright green mats while *B. nelsoni* is a form with long pointed leaves that grows in the Wyoming and Colorado region.

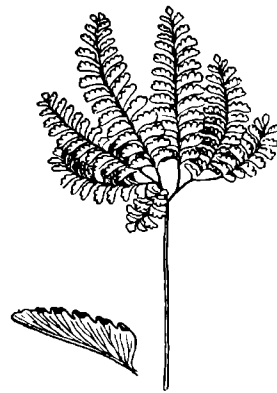
Probably of little or no direct economic importance to man. It may serve as food and shelter for minute animals that provide basic food for larger animals that have value to man. The plants have an esthetic appeal because of the place in which they grow and because of their fresh greenness.



Rock-cap Fern



Oak Fern



Maidenhair Fern

DIVISION III. PTERIDOPHYTA Order Filicales. Family Polypodiaceae

1. Rockcap Fern *Polypodium virginianum* 2. Resurrection Fern *P. polypodioides*

Fronds to nearly 1 ft. long, evergreen, produced in rows, from a brown, densely scaly rootstock; smooth on both sides in (1), but grayish with fine scales beneath in (2). The parts of the blade seem cut almost to the central axis but each part is not separated and borne on a short stem as in the Christmas fern. The general shape of the blade may vary from triangular to oblong or even to long pointed.

From eastern Alberta to Newfoundland and south to Georgia and Arkansas, for (1), with close relatives in Europe which were long thought to be of the same species. (2) ranges from Iowa to Delaware and south into tropical America and in South Africa.

On dry rocky ledges, on boulder piles, on tree trunks, or even on rich woodland soil, doing best on slightly acid soils.

The spore-bearing spots borne on the undersides of the fronds usually near the tip, are round spots which are not protected as in some other ferns. Sometimes these spots are so crowded as to seem to be continuous. They appear midway between the midrib and margins of the part they occupy.

A decorative fern of gorges and rocky exposures; survives some exposure to sun and may be transplanted but should be left in natural setting since nurserymen supply plants more likely to survive change. Fronds curl in dry weather or in winter but recover with moisture. Known sometimes as "female fern," and a medicine supposed to have purgative powers is extracted from the rootstock.

Oak Fern *Dryopteris disjuncta*

Fronds reach a height of 1½ ft., are smooth, except that the main axis may be finely fuzzy; rise in a row from rootstock; are thin, not evergreen. Stipe pale yellow, maturing to a greenish-brown. Blade triangular in general outline, and in three main parts; in this respect, differing from the long beech fern *P. polypodioides*, the broad beech fern or southern beech fern *P. hexagonoptera*, which are with the pinnae connected to the main axis without separate stalks.

From Alaska to Labrador and Newfoundland, south to Virginia and in the northern parts of Europe and Asia.

Rocky woodlands and slopes and at the margins of swamps commonly where the soil is slightly acid but almost always where there is rather deep shade.

The spore-bearing spots are on the underside of the pinnules arranged usually near but not at the margins and appearing more naked and exposed than many similar spots in other ferns. They are not borne on special fronds.

This fern rarely grows in abundance in any one spot and lacks the lacy attractiveness of many other species. It provides a measure of beauty in dense, shaded woodlands at times of the year when other plants of the region are not conspicuous.

Maidenhair Fern *Adiantum pedatum*

Height of fronds to 20 in. Rootstocks: slender, creeping, black, wiry, and producing fronds in rows. Stipe of frond slender, tough, shining, brownish-black, forked unequally to make a fan-shaped top which is held more or less horizontally. Each branch of stipe bears 5-9 branches which bear thin irregularly oblong pinnules which are lobed on upper margin. Whole frond wax-coated, and sheds water. Not persistent in winter. Southern maidenhair, *A. capillus-veneris*, has main stipe unbranched.

Northern maidenhair, from Minnesota to Nova Scotia and south to Georgia, Oklahoma, and Louisiana and in Asia. Southern maidenhair, from British Columbia to Missouri and Virginia and escaped from cultivation elsewhere.

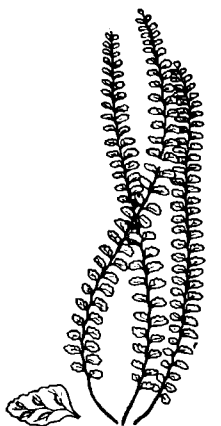
Wooded, well-drained, rich-soiled slopes, without much preference as to acidity, but doing best where the acid content is low. Should have shade. Color changes due to maturity from green to brown and red-brown.

Spore cases borne in interrupted rows of fruit spots under the downward and inward-bent tip margin of the pinnules, the pinnule margin providing some protection as a shield and limiting slightly the direction in which the spores may be freed. The whole spore-producing section makes a series of crescent-shaped formations along outer edge of each pinnule except near tip.

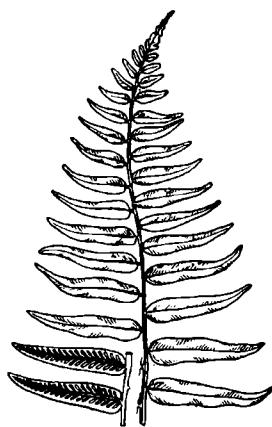
Easily cultivated and transplanted and for sale by gardeners. Fronds wilt quickly when cut, so are not useful for picked bouquets. Species named by Linnaeus in 1753 from plants from Canada and Virginia. Name may come from hair-like resemblance of stipe or because of use of European Venus's hair fern in hairwash concoctions.



Bracken



Maidenhair Spleenwort



Lady Fern

DIVISION III. PTERIDOPHYTA Order Filicales. Family Polypodiaceae

Bracken, Brake

Pteridium aquilinum latiusculum var.

Height to 3 ft., with widely spreading fronds that are twice pinnately divided from a central axis. Stipe tough, brown, coarse, erect. Branches twice pinnate. Blade coarse, dull green, with the upper pinnules undivided. Rootstock tough, the diameter of a pencil, and spreading rapidly underground, sometimes as much as 50 ft. in a year and producing a row of erect fronds above ground, thus indicating its position. The fronds die back each year.

Newfoundland to Wyoming, Arizona, and Florida, being locally very common. A closely related European bracken is *Pteris aquilina*, long thought identical with the American species. Linnaeus named the European bracken in 1753.

In open woods, stream margins, banks, and slopes but most commonly where it is relatively dry and where the soil is neutral or strongly acid. Its abundance does not seem to be affected by neutral or acid soil.

The margins of the pinnules are incurved all around beneath to cover the sparsely hairy, sporebearing areas. These fertile margins are continuous and not interrupted as in the maidenhair and some other ferns. The fruiting areas mature in August although new fronds are being produced throughout most of the summer growing season, some of which of course do not reach maturity.

The young fronds may be eaten either raw or cooked, particularly if gathered in spring when they are tender. Rootstocks used by Indians in making baskets and fronds as a thatch. Brake is not easily transplanted. Name may refer to the Greek "pteris" meaning wing. A section of stipe is reputed to resemble the print of the devil's hoof.

1. Maidenhair Spleenwort

Asplenium trichomanes

2. Blackstem Spleenwort

Asplenium resiliens

3. Ebony Spleenwort

Asplenium platyneuron

(1) and (2), to 8 in. high; and (3) to 2 ft. high. Fronds all delicate-appearing but evergreen except the erect fertile ones in (3), which are only semievergreen. Stipe and long rachis dark brown in (1) and (3), black in (2). Pinnae almost opposite in (1), mostly opposite in (2), and mostly alternate in (3). They are pointed at the base in (1), "eared" in (2), and in line with the rachis in (3).

(1), from Alaska to Nova Scotia and south to Georgia and Arizona. (2), from Missouri to Pennsylvania and south through Florida, Jamaica, and Arizona to western South America. (3), Maine to Colorado and south to Florida and Texas.

(1), on wet rocks and shady crevices or on dry limestone ledges or in slightly acid soil. (2), on rocks in the shade, usually in slightly alkaline soil. (3), on rocky ledges or clay, either of acid, alkaline, or neutral nature.

Spore-bearing spots few, short, placed near the center along veins in (1) and (2); in (3), like short, oblong dashes starting from the midrib and extending halfway to the margin. In (3), the fertile fronds are erect and the sterile are prostrate, while in (1) and (2) the fronds are alike whether fertile or sterile.

Beautiful little ferns that are rare and, near centers of population, are growing rarer. They do well for a time when transplanted into glass containers indoors, but usually such plants eventually get destroyed. It is better to leave the plants in their natural setting, where they are at their best.

1. Northern Ladyfern

Athyrium filix-foemina angustum

2. Glade fern

Athyrium pycnocarpum

3. Silver-stripe Fern

Athyrium thelypteroides

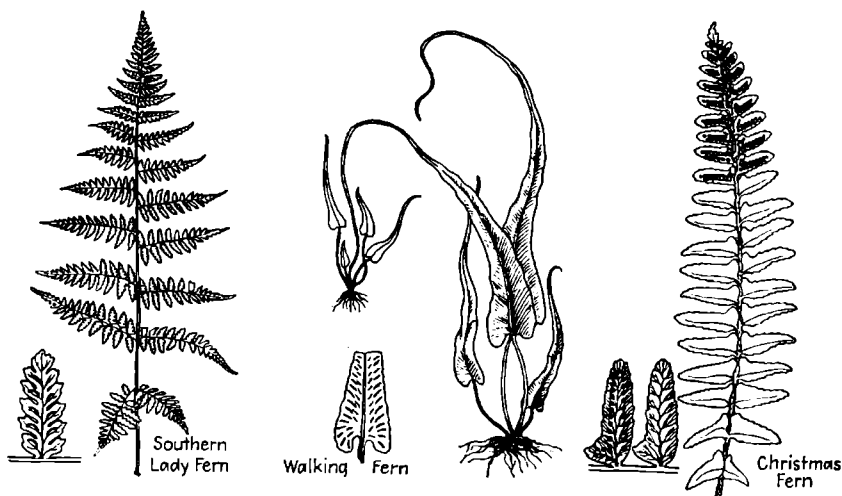
(1), to 3½ ft. and (2) and (3), to 4 ft. tall. Fronds pinnate, tapering at base and tip about equally, with pinnae with entire margins in (3) but deeply toothed in (1) and (2). Stipe yellow to red in (1) and (2), to brown in (3), and scaly below. Rootstock short and horizontal in (1) and (2), slender in (2), producing fronds in clusters in (2) and in short rows in (1) and (3), retaining old stipe base in (1). Stipes of (1), pink with pinnae, pale green in spring but yellow in summer.

(1) Manitoba to Newfoundland, Virginia, and Missouri. (2), Wisconsin to Maine, Georgia, and Louisiana. (3), Minnesota to Nova Scotia, Missouri with variety in Asia.

Moist shaded woods and thickets in all species, with acid soil favored in (1) and (3) and neutral soil in (2). Generally does best in cool spots.

Spore-bearing spots under pinnae numerous; in (1), short, crowded, and hooked; in (2), in long, regular rows; and in (3), shining, and appearing silver-striped. Spores of (1), yellow-brown. Fertile fronds less spreading than sterile in (1); spore-bearing spots in (1), at first horseshoe-shaped, then more linear. Projections at base of stipe good identification.

One of best groups of ferns for replanting about house. (1) gets name lady fern from resemblance to European lady fern, whose spores in shoes are supposed to render wearer invisible and also to confer on such persons second sight, useful in finding lost things, these qualities vanishing when "seed" is lost. Indians used it medicinally to stop urine.



DIVISION III. PTERIDOPHYTA Order Filicales. Family Polypodiaceae

Southern Lady Fern

Athyrium filix-foemina asplenoides

Fronds not evergreen, to 30 in. long, broadest just above first pair of segments, once or twice divided, with ultimate segments grown fast to support rather than on independent petioles, with margins coarsely doubly indented and with pointed ends. Fronds with main axis reddish or yellowish. Rootstock long, horizontal, with some old erect bases of older fronds.

Found where soil is somewhat sour in wet woodlands, swamps, along stream banks and in similar places from Massachusetts to Florida, west to Texas and Missouri, frequently being one of the commonest ferns within this area.

Usually associated with other wet-land semisour soil species. It may form clear stands under some circumstances.

Fruiting bodies are borne halfway between the middle axis of ultimate segments and their margins, incurved, hook-like cases that open from one side and free very dark to black spores. Protecting case may show gland-tipped hairs under the microscope.

This species was first observed about 1803 by the botanist Michaux who cruised the eastern parts of the United States for plants for France. It was placed in this genus by Amos Eaton, the engineer, geologist, and botanist, about 1817.

Walking Fern

Camptosorus rhizophyllus

Fronds evergreen, close to ground or only slightly raised; shaped like long, slender spearheads; tips, touching ground take root and produce clusters of similar fronds thus giving rise to common name, walking fern. Fronds to nearly 1 ft. long, though more commonly about 4 in. Stipe brown at base. Blades with wavy margins; their veins form rather large areas like a net. Rich, waxy, blue-green.

From Minnesota to southern Quebec, south to central Georgia and eastern Oklahoma.

Commonly on cliffs, and most abundant on limestone outcrops, though may grow on other rocks, in shade, and even on rich humus or tree trunks. Does not normally favor acid soils.

Fruiting bodies borne in long, slender, irregularly placed slits or streaks on the underside of the blades of the fronds, and appearing brown to blackish or rusty depending on degree of maturity reached. One of the most easily identified ferns because of these spots and the rooting habit of the frond tips.

Notable fern because of interesting way of spreading and also because it responds readily to transplanting into indoor table gardens in jars and aquariums. It can be purchased from some nurserymen and because of usual rareness should not be collected from the wild state except under favorable conditions.

Christmas Fern

Polystichum acrostichoides

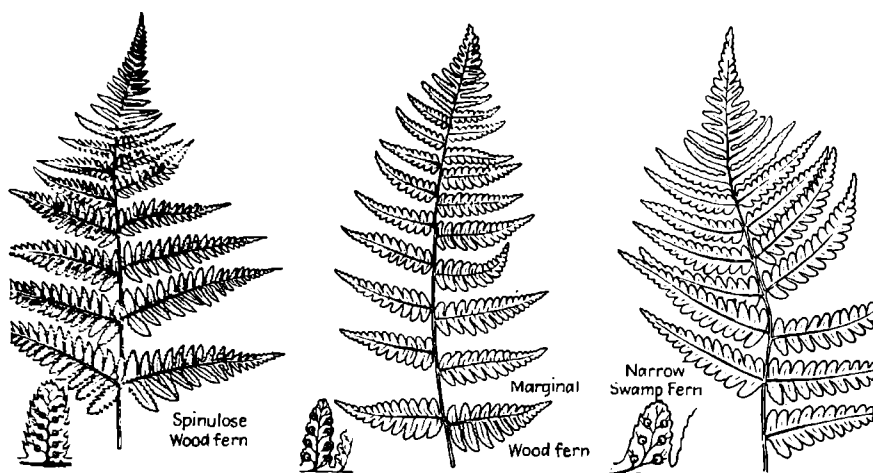
Fronds more or less prostrate, evergreen, from 10-30 in. long, dark green above and lighter beneath. Sterile fronds, shorter than those which bear spores; fertile, more erect. Fronds of the year gray-green and unroll from crociers or "fiddle-heads" at tips. Second growth of fronds may appear in August if preceding month has been unusually rainy. One variety has crisped or ruffled edges that make it exceptionally beautiful. Related holly fern *P. braunii* has blade twice pinnate.

From Nova Scotia to Wisconsin, south to central Florida and eastern Texas with the related holly fern with wider range extending to Alaska and Newfoundland.

In woods and shaded swamps and thickets or in rock crevices irrespective of whether the soil is acid, neutral, or alkaline but rarely where direct sunlight strikes for any considerable period of time.

Fertile fronds bear spores in spots clustered near the central line on the underside of the modified terminal pinnae. Pinnae bearing spores are usually smaller and more widely separated and set at a more acute angle with the main axis than are the sterile pinnae. Spring fronds bear spores in July and the second-growth fronds in September.

One of earliest of ferns to develop each season. Fronds, because of graceful form, deep green color, and evergreen qualities, are used considerably in decorations, particularly in funeral sprays and at Christmas. Much more beautiful and appropriate in natural setting but have a commercial value for cut fronds and for living plants.



DIVISION III. PTERIDOPHYTA Order Filicales. Family Polypodiaceae

1. Spinulose Woodfern *Dryopteris spinulosa*

2. Evergreen Woodfern *Dryopteris intermedia*

Fronds of both to 30 in. long and evergreen except that fertile fronds of (1) are not evergreen. Rootstocks produce fronds in short rows in (1) and in clusters in (2). Main axis (stipe) of (1) with pale brown scales; of (2), with light or dark brown scales. Fronds of both dark, rich green and ultimate divisions are more or less leathery though somewhat less so in (1). In (1), the inner pinnules of basal row are longer than next above; in (2), they are shorter.

(1) From Newfoundland to Virginia and west to Missouri and Idaho and in Europe and in Asia as well. (2) From Newfoundland to Alabama and west to Missouri and Wisconsin, being a reasonably common fern, whereas (1) is a really common species.

(1) Favors soil that is reasonably acid while (2) is found on soils that are either acid or neutral. Both favor shady slopes or swamps where there is an abundance of suitable moisture.

Spore-bearing spots on undersides of pinnae are halfway between midrib and margin in (1) and near center or on midrib in (2). Spore-bearing areas round in both except that those of (1) are more likely to be kidney-shaped. Hybrids may form between these two and the two discussed in the next column.

Beautiful and justly popular ferns that are usually hardy and survive transplanting well. Fronds unfortunately cut and sold for ornament though it does not seem that this should be permitted. Apparently, they are not generally protected by any special laws.

1. Marginal Woodfern *Dryopteris marginalis*

2. Goldie's Giant Woodfern *Dryopteris goldiana*

Fronds of (1) to 30 in. long; of (2), to 40 in. long; of (1), evergreen; of (2), surviving late into season but not evergreen. Rootstocks produce fronds in clusters in both. Main axis of (1), with shining brown scales; of (2), with dark-brown scales below. Both have fronds that are a dark, rich green and are more or less leathery. In (2), there is a tendency for the basal pinnae to be narrowest near their base while this is hardly so in (1).

(1) Found from Nova Scotia to Alabama and west to Oklahoma and Minnesota and in British Columbia as well. (2) Found from Newfoundland to South Carolina and west to Minnesota. (1) is usually a very common species while (2) is rather uncommon.

While (1) favors rather acid soil, it grows satisfactorily in others. (2) is usually found in soils that are neither acid nor alkaline. Both favor shady slopes or swamps where the water supply is suitable.

In (1), the spore-bearing bodies are borne along the margins of the undersides of the ultimate divisions. In (2), they are borne conspicuously in two rows nearer the center or the midrib. In each case, the spore-bearing areas are essentially round. They may hybridize with each other and with the other species on this page.

Beautiful and justly popular ferns that are too hardy for their own good. They are of course cut for ornament but deserve much more protection than they get.

Narrow Swamp Fern *Dryopteris cristata*

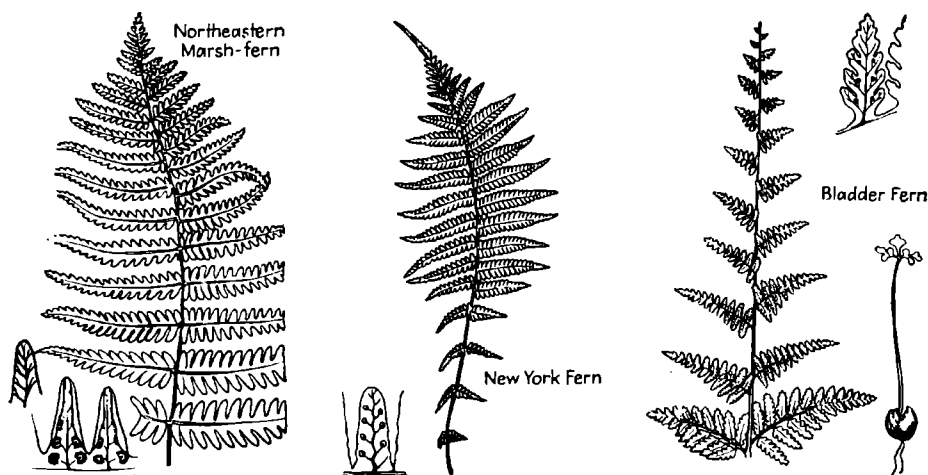
Fronds to 40 in. tall, almost but not completely evergreen, borne in clusters from the horizontal rootstock that is covered with pale brown scales. Main axis of frond sparingly scaly. Lower pinnae definitely widest at base and may be in more compact triangles than indicated in sketch. Fertile fronds wither quickly in fall but those that are sterile may be almost evergreen.

Found from Newfoundland to Virginia and west to Arkansas and Idaho, with range extended east and west to Europe and on into Asia. It is a relatively common plant throughout its range.

Favors soil that is approaching an acid condition. Commonest in bogs, marshes, wet meadows, thickets or on springy slopes and in gorges.

Spore-bearing areas are borne between the midrib and the margin of the pinnules, usually more or less squarely across branches of the veins. Margins of the pinnules saw-toothed. Spore-bearing bodies round, without hairs evident in some related species.

A fine plant identical with the plants found in Europe. The fronds are probably generally narrower than those here figured and are often characterized by having the divisions twisted so that they are normally held in a horizontal position rather than in the plane of the frond as a whole.



DIVISION III. PTERIDOPHYTA

Order Filicales. Family Polypodiaceae

Northeastern Marsh Fern

Dryopteris thelypteris

Fronds to 30 in. long, gray-green in general color, not evergreen, fertile ones being at best in midsummer; borne in a row on slender, horizontal rootstock. Main axis (stipe) somewhat bronzed in its lower areas. Expanded part of frond finely downy. Pinnae deeply cut into rather blunt sections. Veins in the sterile fronds forked; those in the fertile fronds unbranched.

Found from Newfoundland to Georgia, west to Oklahoma and Manitoba. Also found in northeastern Asia. Closely related to New York fern described in next column and to bog fern suggested there.

Does best in soil where acidity is low. Nevertheless, it is found in bogs as well as in marshes, swamps, and wet woodlands where the acidity may vary considerably.

Fertile fronds have their margins curved inward in part over the spore-bearing areas and their veins are unbranched as already suggested. Spore-bearing areas are midway between the midrib and the margin of the pinnule and are commonly rather crowded.

This is distinct from the European fern and is usually known as variety *pubescens* rather than as simple species *D. palustris*. That American and European plants were not the same was recognized only comparatively recently.

New York Fern

Dryopteris noveboracensis

Height of fronds to over 2 ft. Rootstock slender and producing fronds in a short row. Fronds delicate, yellow-green, thin, with longest pinnae in middle and forming a blade which tapers to each end conspicuously. Pinnae hairy on heavier veins on undersides and veins are mostly unbranched. Stipe relatively short, pale green, and only slightly scaly, slender.

From Minnesota to southern Newfoundland, and to Arkansas and Georgia. The related bog fern *D. simulata* extends the range to Prince Edward Island in Canada and south to Alabama. It lacks the conspicuous tapering of the blade at the base.

Moist thickets, swamps, and woods where the soil tends to be slightly acid. Often grows to cover considerable areas to the exclusion of other plants.

Fertile fronds appear in summer and superficially resemble those that are sterile. Fruiting spots on undersides of pinnules, rather round and borne just back from margins. Protecting portion is covered with fine, glandular hairs.

Most beautiful in its natural setting but, because of its habit of growing in rather clear stands, it is popular with those who collect ferns for decoration for special events. Fronds are not sufficiently hardy to hold for use commercially.

1. Brittle Fern

Cystopteris fragilis

2. Bladder or Bulblet Fern

Cystopteris bulbifera

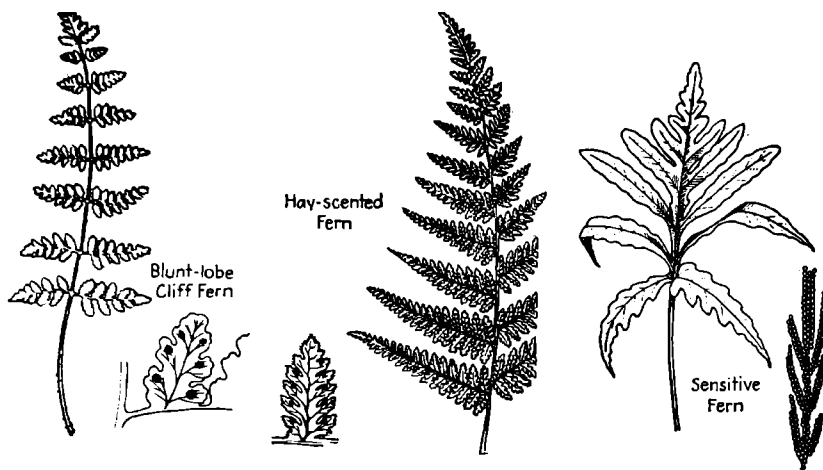
Fronds from 1 ft. in (1) to 4 ft. long in (2); rising in clusters from usually short rootstocks but, in (2), often reclining or nearly so. Stipe brown in (1) and pinkish in (2); rachis green and smooth in (1), and pinkish in its lower portion in (2). Whole fronds appear to be long and tapering, more particularly in (2), giving always the general appearance of being weak and brittle.

(1), from South Dakota to Nova Scotia and North Carolina, Georgia, and Arkansas in its different varieties. (2), from Newfoundland to Manitoba and south to northern Georgia and Arizona.

(1), on slopes and ledges partly sheltered from sun; on soils usually neutral. (2), where soil is alkaline or neutral; may appear in swamps, but usually on limestone exposures.

Fruiting spots round and on center of lateral veins that branch from central veins on undersides of fronds, in (1). In (2), same general description might hold, but some pinnae bear, in their axils or lobes, small green reproductive bulblets which give plant its common name. These are usually conspicuous in the mid- and late summer months.

These ferns ornament many a rock exposure in gorges or hang gracefully over some woodland bank. In hot weather of summer, fronds of (1) turn yellow, then brown, but may recover if wet weather returns.



DIVISION III. PTERIDOPHYTA

Order Filicales. Family Polypodiaceae

Blunt Lobe Cliff Fern

Woodsia obtusa

Fronds to 3 ft. long, arising from very short rootstocks. Sterile and fertile fronds resemble each other in general but sterile ones are evergreen. Unlike the bladder fern, it has fronds minutely hairy and scaly and veinlets show as small markings at lobe tips. In sun, fronds become yellow. Stipe and rachis pale green to yellow with scales extending up stipe and rachis to glandular hairs above. Stipe jointed above rhizome and breaks at joint.

From southeastern Canada through to Alaska and south through northern United States and in the Rockies. The related rusty cliff fern *W. ilvensis* is found also in northern Asia and Europe.

Found on well-drained, shady soils, generally where the soil is neutral; often in cracks in walls or even in sand.

Fructifying dots round, large, and on or below minutely toothed lobes of smaller parts of fronds, arranged in irregular rows, usually toward margin, and commonly terminate short veins branching from main vein of lobe. Mature about July and their protecting covers are shed, spreading back to form small black stars with brown centers.

This species was originally discovered in Pennsylvania. It is a pretty fern when it is fresh and young, but becomes slightly when mature as fronds become blotched with white. It is at its best in June. It does not transplant well into indoor ferneries under ordinary treatment and should be left where it may have established itself naturally.

Hay-scented Fern

Dennstaedtia punctilobula

Height from 1-2½ ft., fronds appearing in rows arising from slender rootstocks. Stipe or frond stem shining brown. Axes of branches pale green. Finest subdivisions thin, paper-like, with downy hairiness and a pale yellow-green color; with appearance of being long and tapering from basal pinnae nearly 5 in. long. Fronds last through summer, and covered with slightly sticky hairs; fragrant because of wax they produce.

Southern highlands of Georgia to Arkansas and north to Minnesota and Nova Scotia, being commonest in poorer soils and waste places.

Usually, in open dry woods or rocky slopes and only rarely in swamps. Soil preferably somewhat acid in nature. Highly sensitive to early frosts and may bleach almost white in autumn.

Spores in cases, borne in a recurved toothlet of pinnae of fronds, with one sorus of spore cases usually at upper margin of each lobe. Sterile and fertile fronds superficially much alike. Cup-like indusium bearing spore cases unlike and not easily confused with similar structures in other ferns.

Discovered by Michaux in Canada. Formerly considered in genus *Dicksonia*. Possibly because of fragrant wax is not palatable to cattle and therefore multiplies extensively in suitable pasture lands. Fragrance most conspicuous in ferns grown in dry, sunny spots.

Sensitive Fern

Onoclea sensibilis

Height to 30 in. Sterile fronds broad, in general rather triangular and like coarse feathers, yellowish or sometimes bluish-green, with segments near tip not cut through to midrib. Fronds held more or less vertically or arching gracefully but slightly. Rootstock shallow, much branched and sending up fronds in rows, the sterile appearing early in the season and the fertile usually coming in the autumn.

From Newfoundland to Saskatchewan and south to Florida and Texas with a close relative in Asia. Locally very abundant and conspicuous.

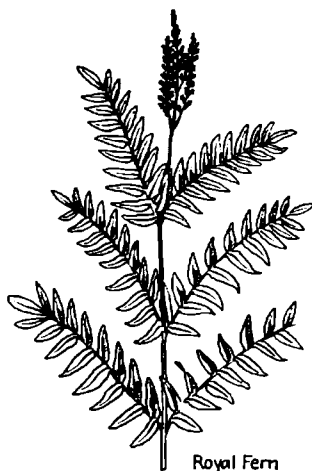
Swamps, wet depressions, spring-fed fields, and roadsides, favoring neutral soil but tolerating some acidity. Its sterile fronds do not survive a frost.

Fertile fronds produced in late summer persist through winter and produce spores in at least 2 years; may persist battered even more than 2 years. Spores bear chlorophyll and grow at once into sex-bearing stage. Shape of spore-bearing parts of fertile fronds has led to name of beadfern, which is not commonly used, however.

Fern was collected first in America in early eighteenth century and described by Linnaeus in 1753. American variety was named in 1937 by Edgar T. Wherry. Common name may come from fact that it wilts quickly when cut or touched by frost but it is hardy in other ways. Is grown relatively easily.



Ostrich Fern



Royal Fern



Interrupted Fern

DIVISION III. PTERIDOPHYTES Order Filicales

Family Polypodiaceae

Ostrich Fern *Pteris nodulosa*

Height of sterile fronds to 8 ft. Stipes: brown and scaly, with whole, sterile fronds, coarse, narrowest at base, and narrowing more gradually toward tip, in this latter respect differing from cinnamon fern which it otherwise slightly resembles. Rootstocks stout, growing vertically out of ground, but bearing underground, brown, chaffy runners which reach surface at their tips and bear fronds. Sterile fronds surround fertile fronds to form a sort of vase; wither late summer.

From Alaska to Newfoundland and south to northern Virginia, being much more common in northern part of range or at least more common in United States along northern border.

In swamps, on rubble-covered slopes, in open lowland, and wooded flats where there is an abundance of humus and where the soil is neither strongly alkaline or acid but essentially neutral.

Spores produced on special fronds borne in center of year's cluster from one rootstock in late summer or autumn and looking plume-like in shape or possibly like a badly withered sterile frond; light green at first, then dark green, then brown. Spores not freed until spring so fertile fronds must survive one winter and perhaps two.

Described in 1803 by Michaux from a plant from Montreal but genus was originally described by Rafinesque. Common name undoubtedly refers to resemblance between sterile fronds and ostrich plumes. One of most beautiful ferns of its range.

Royal Fern *Osmunda regalis*

Fronds to 5 ft. long, clustered, and beautiful; divided and in turn divided again; with those that are sterile, the divisions are well separated. Fertile areas are in uppermost part of fronds where units are much more crowded but finer. Axes relatively fine but strong. Fronds generally a pale green and units are practically entire.

Found from Newfoundland to Florida, west to Texas and Saskatchewan. Also found south into South America and southeast into West Indies. It also occurs in other parts of the world. In our forms, base of each pinnule is more likely to be somewhat heart-shaped than in European forms.

Found in moist woodlands, in marshes, swamps, and sometimes on wet cliffs. It usually favors soils or waters that are somewhat acid though it may survive if planted in neutral areas if other conditions are suitable.

Fertile fruiting fronds appear as dense clusters of light brown structures that on examination are seen to be made up of dense masses of light brown spore cases. These are darker in early stages and light brown when spores are being freed.

A beautiful fern which should be protected. Where transplants are made they should be made only from dense masses that will reconstruct themselves. Sometimes known as "male fern"; a mucilage from stem is used in treating coughs and diarrhea.

Family Osmundaceae

Interrupted Fern *Osmunda claytoniana*

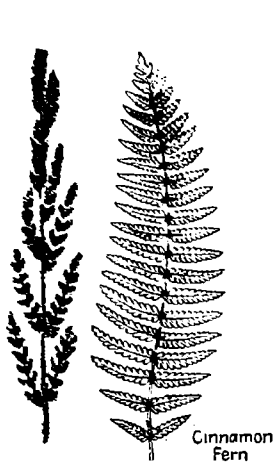
Fronds to 5 ft. long, woolly when young, once divided, without the tuft of brown at the base of each section that distinguishes the cinnamon fern. Fertile pinnae in 1-5 closely placed pairs, with sterile pinnae above and below producing the "interrupted" effect that gives fern its common name.

Found in eastern Asia, and in eastern North America from Greenland to Georgia, west to Arkansas and Manitoba. Particularly common along coastal areas. It is also sometimes one of commonest plants in upland wooded areas often making an almost pure stand.

It favors partly acid soils and is at its best in moist woodlands, in open brushlands, or along the margins of swamps and marshes.

Fertile areas are always conspicuous and are at their best in May. After they have shed their spores, the gap in the frond makes the fern an easy one to identify even at a considerable distance. The presence of these middle fertile pinnae is unique among our ferns.

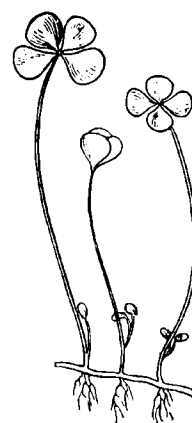
The genus *Osmunda* may refer to the Saxon god Osmunder or Osmund, the Waterman, reputed to have hidden his family in a clump of the related royal or regal ferns. Interrupted ferns are easily transplanted and make good ornamentals for use on the shaded side of a house in poor soil or good loam.



Cinnamon Fern



Rattlesnake Fern



Water-clover Fern

DIVISION III. PTERIDOPHYTA Order Filicales

Family Osmundaceae

Cinnamon Fern *Osmunda cinnamomea*

Fronds to 5 ft. long, arising from creeping underground stem in clusters that look like graceful bouquets of wands. Usually in center of cluster are a few fertile fronds. Sterile fronds easily identified by tufts of brown wool that appear at base of each pinna. Main axis brown, woolly; fronds are at their best in midsummer. Young fronds conspicuously woolly.

Found from eastern Canada through eastern United States, with a closely related variety found in tropical regions to south. Its close relatives include interrupted fern and royal fern discussed on preceding page.

Found in wet woodlands, marsh borders, on wet slopes, or sometimes even on wet cliffs. It is rare where acid content of soil is low and it is not at its best where that content is high.

Fertile fronds are erect and nearly as long as those that are sterile. They bear no sterile pinnae and in this respect differ from interrupted fern with its frond of mixed nature. Spore cases in fertile frond become cinnamon brown before withering away. They spring from short rootstocks in early summer.

This fern transplants easily and is more popular than interrupted fern because of uniformity of fronds. It is hardy in a variety of places but does best where there is reasonable shade.

Family Ophioglossaceae

Rattlesnake Fern *Botrychium virginianum*

Height 6 in. to 3 ft., with stem of single frond fleshy. Frond part sterile and part fertile. Veins of sterile part not netted. Sterile frond triangular, with three obvious, much divided parts held horizontally. From sterile frond rises fertile frond, often an additional foot. Frond grows from mass of thick, fleshy roots from depth of nearly 1 ft. underground, new frond of each year springing from withered base of last year's frond, unfolding in its annual development.

Throughout eastern United States and southern Canada, with close relatives farther north and in the Old World. Closely related grape ferns of many species may extend group still farther, some recognized species forming hybrids with others.

In woods, moist thickets, swamps, and similar shady places where the soil tends to be neutral to slightly acid.

Spores bright yellow and mature in June; develop into underground plants which bear sex organs and from which more conspicuous plants arise. May be grown by raising these sexual stages from spores, but it is too difficult a process to be attempted by amateur. Plants may be purchased from nurserymen. Because of depth of root system, does not transplant well from rocky ledges.

This species was originally described by Linnaeus in 1753 from plants brought to him from Virginia in spite of fact that species grows in Europe and Asia. Indians used plant medicinally in treatment of bites. Vernacular name probably from fancied resemblance of clustered sporangia to snake's rattle.

Family Marsileaceae

Water-clover Fern *Marsilea quadrifolia*

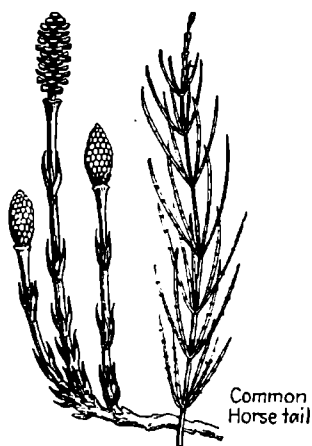
Fronds look like parallel-veined, four-leaved clovers, parts being almost exactly equal and forming a quarter of a circle about 1 in. across. Rootstock slender, tough, and branching to interweave with others forming a dense mat with assistance of root-like branches.

Found largely wherever introduced, coming to America through Connecticut in 1862 and establishing itself where introduced elsewhere through northeastern United States particularly in New York, Pennsylvania, New Jersey, and Maryland.

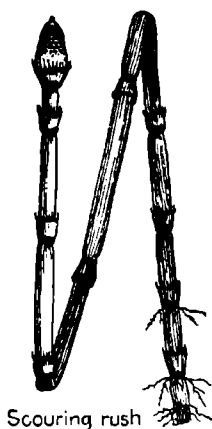
It is aquatic or nearly so and floats on still waters or establishes itself on mud flats at edges of ponds, lakes, and streams where soil is neither acid nor alkaline.

Fruiting bodies appear in late summer and through winter, like small, dark, long peas or beans borne on short branches from near the base of the fronds. These are very hardy and may be dried for years only to resume growth and development when they have access to proper water and temperature.

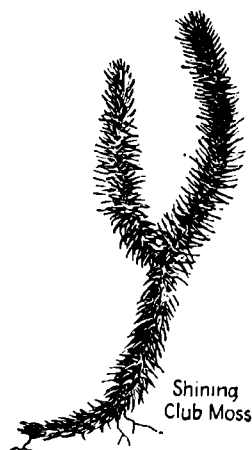
Plant may have some value in anchorage of soil at margins of waterways and it is usually more beautiful than many plants which grow in same place. May get out of control, however, and spread to territory where it is not wanted but at all events it provides food and some shelter for minute organisms that make their way into open water to be eaten by fish.



Common
Horse tail



Scouring rush



Shining
Club Moss

DIVISION III. PTERIDOPHYTA

Order Equisetales Family Equisetaceae

Common Horsetail *Equisetum arvense*

Sterile stems appear after fertile ones have died back in late spring. Sterile stems are pale green, with whorls of slender green branches arising from the joints, are to 2 ft. high with the branches branched or unbranched. There are 12-14 furrows on the rough stems. Sheaths at base of joints are funnel-shaped.

Native of North America as well as of Europe and Asia. Found in America from Newfoundland to Alabama and west to Alaska and California but possibly more common east of the Mississippi than west of it. Related *E. sylvaticum*, wood horsetail, and *E. pratense*, thicker horsetail, also have fertile and sterile stems separated.

Fertile stems arise in season from horizontal underground stem, reach a height of 10 in., appear weak, flesh-colored, or brown and terminate in a cone-like spike about 1 in. long from which clouds of spores are freed. These spores make small plants that bear either male or female sex organs.

Found in sterile or sandy soil such as on railroad embankments, in road cuts, or in thickets, woods, open meadows, or other places irrespective of whether soil is acid or alkaline. Roughness of stems due to silica deposited in the stem surface. Ash from burned stems may still be rich in fine silica.

Useful as soil anchors because of branching underground parts. May become a pest in some fields but is usually easily controlled by cultivation. Interesting because of the fact that much plant life of the Carboniferous time when part of our coal was laid down was of this type though considerably larger.

Scouring Rush *Equisetum hyemale* (prealtum)

Stems to 3 ft. tall, arising from a horizontal branching underground system, hollow, evergreen, grooved, with short sheaths at the joints but no branches such as are evident in *E. arvense*. Sheaths at joints, blackish teeth, and disappear early in season. Stems rough and much coarser than in *E. arvense*.

Found native through most of the United States and Canada and so closely related to European species that many question that there is a real difference. Certainly it is slight. The species name *prealtum* is applied to the American form and *hyemale* to the European form.

Fertile portion borne at top of stem and appears like a small cone-like spike that is erect and only slightly thicker than diameter of the stem at the point of attachment. Cones mature and free their spores from May to September and of course persist through the year.

Common in springy or dry sandy, open banks or in woods, in noncalcareous or alluvial soils, on railroad embankments, on stream borders and any moist, sterile slope, often making an almost pure stand over a considerable area. It is not evident in soils that are excessively acid or excessively alkaline.

Useful as a soil anchor either at stream edges or on bare steep exposed slopes. Stems have been used as scouring rushes because of the embedded silica that helps remove grease and dirt, or the ashes may be used in making a scouring mixture effective because of the persistent silica.

Order Lycopodiales Family Lycopodiaceae

Shining Club Moss *Lycopodium lucidulum*

Stems trailing, branching, rooting where in contact with the soil and ascending at the free ends to a height of nearly 1 ft. Leaves rather evenly distributed over the stem but with year's growth usually relatively well-marked, shining dark, rich green about 1/4 in. long and arranged all around the stem.

Native of North America and found from Newfoundland to Alabama and west to Missouri and Washington. Not usually common in the lowlands and at its best in Canada where it is found clear across to British Columbia. A number of closely related species.

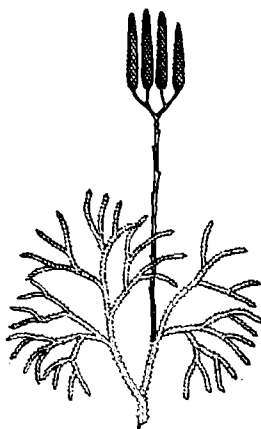
Reproduction is by division of the vegetative parts or by the shedding of special reproductive structures which are freed from the upper parts of the branches and are somewhat triangular and wafer-like, or it may be by means of spores, which are shed and form underground plants.

In suitable areas this may be frequent in damp, gravelly, or sandy woodlands or in deep humus but more particularly in woodlands in which hemlock is found growing. Spore cases are bright yellow and become mature from August through September. They are borne at the bases of the uppermost leaves.

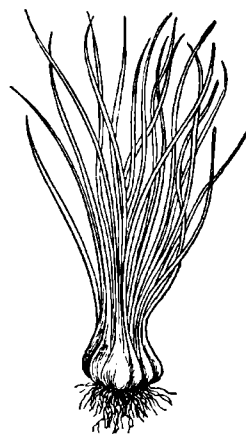
In the club mosses the conspicuous part of the plant is essentially spore-producing (sporophyte) while in the true mosses the conspicuous part bears real sex organs whose fertilized egg produces the spore-bearing part of the life cycle.



Common Club Moss



Ground Pine



Quillwort

DIVISION III. PTERIDOPHYTA

Order Lycopodiales

Family Lycopodiaceae

Family Isoetaceae

Common Club Moss

Lycopodium clavatum

Stems run along just under the surface of the ground or at the surface, forking freely and growing to great length, rooting at intervals where contact with the ground is established. Usual height is to about 10 in. Leaves crowded, about $\frac{3}{4}$ in. long, bristle-tipped, silvery green when new and dark green when old.

Found widely distributed over the world. In North America, found from Labrador to North Carolina and west to Washington and Alaska, with closely related species extending the range. It is found at high altitudes in the tropics in both hemispheres. Fruiting regions are longer than in *L. annotinum*.

Spore cases in cylindrical spikes borne on forked branches which have few and well-separated leaves. Sterile leaves are entire and bristle-tipped, while in *L. annotinum* they lack the long bristles. Spores mature in August and September and are freed in great clouds when ripe.

Found in open fields or woods or mixed with grasses commonly on soil too poor or sterile to support other plants, but usually on soils relatively free of lime. May do well on sand or gravels that would support few competitive plants.

Used in making Christmas wreaths, unfortunately. Spores used in expensive toilet powders, as coatings for pills to prevent them from sticking together, to form a basis of flashlight powders, and in certain kinds of fireworks. Plants collected by campers to fill mattresses but are too slow growing to survive excessive collecting. See *cannel coal* p. 25.

Ground Pine

Lycopodium complanatum

Long horizontal branching stems at or just beneath the surface of the ground bear erect branches. Stem forks freely and erect branches are to 5 in. long, which may grow about 2 in. a season. Leaves are of two kinds and are arranged in 4 rows to make a flattened frond which fans out widely in one plane.

Native of North America and found here from Newfoundland to Georgia and west to Kentucky and Idaho. Systematic botanists contend that the species *L. complanatum* really belongs to a more northern variety, while the plant long considered as of this species is really *L. flabelliforme*.

Fertile branches are forked into 3 or more sections and are to 4 in. long, or about equal to the erect sterile part. They are poorly supplied with leaves in the lower parts but the spore-bearing part is closely crowded with spore-bearing leaves that are more or less yellow.

Found in open woodlands or on dry gravelly banks, doing reasonably well in a soil of some acid content but not on soils rich in lime. The spores are wind-blown and germinate to produce underground sex-organ-bearing structures that are small and rarely known. From these arise the plants we see.

Plants are used somewhat in the making of Christmas decorations and the spores have uses similar to those suggested for *L. clavatum*. For general characters of club mosses see account of *L. lucidulum* on a previous page. Worthy of protection. Undoubtedly useful to some extent as a soil anchor.

Quillwort

Isoetes engelmanni

Plant appears to be much like a tuft of grass, but the bases of the leaves are swollen and bear masses of spores; the leaves are not sheathed to a stem as in grass and are more delicate than the usual grass leaf, being somewhat 4-sided. They may be to 20 in. long in some species but are always in rosettes that arise from a branching root system.

Found in marly ponds, in the mud, and in rivers and streams and lakes from Maine to Pennsylvania and west to Missouri and Illinois. At least 5 species are recognized in the eastern United States region, based largely on microscopic characters of the spores.

Bases of the leaves are really sacs of spore cases with the outer ones bearing larger spores that produce plants bearing the eggs. The bases of the inner leaves bear smaller spores that produce plants producing the sperms, which fertilize the eggs.

While these plants are found in or near marl ponds in which there is much lime they are usually not found where the soil is strongly acid or strongly alkaline. They may be found on almost dry shores in gravel, or relatively deep in lakes and completely submerged. Plants reach maturity in July-September.

Probably are of little or no economic importance but are tremendously interesting to botanists who consider that they represent a degree of development of the pteridophytes that is approximately equal to that of the more primitive seed plants.

DIVISION IV. SPERMATOPHYTA

Approximately half the described plants of the world belong to the division Spermatophyta. Some 133,500 species of plants have been placed in this division. These are divided roughly somewhat as follows:

Subdivision Gymnospermae. Pines and their relatives.	500 species
Subdivision Angiospermae. Flowering plants.	133,000 species
Class Monocotyledoneae	24,000 species
Class Dicotyledoneae.	109,000 species

In these plants as in the pteridophytes, the conspicuous part seen is sporophytic rather than gametophytic. They differ from the pteridophytes in that they bear seeds. Within these seeds, the female gametophyte develops while the male gametophyte is found in the pollen that reaches the female gametophyte in various ways.

In the typical gymnosperm represented by the pines, the spore case in which the female gametophyte develops is borne naked on a special scale while in the angiosperms the corresponding scale encloses the spore case, making what we call the *pistil*, or at least the ovary part of the pistil. Within this ovary are the ovule or ovules that ripen to become seeds.

Just as the spermatophytes appeared more recently on the earth than the pteridophytes, bryophytes, and thallophytes, so the angiosperm division of the spermatophytes appeared more recently than did the gymnosperms.

Detailed consideration of plants in these major groups may be found as follows:

Gymnosperms	pp. 86-97
Angiosperms.	pp. 98-342

SUBDIVISION GYMnosPERMAE

In the subdivision to which the gymnosperms belong, 7 major orders are recognized. Three of these are represented only by fossil remains. They are the Cycadofilicales or pteridosperms, the Bennettitiales or hemicycadales, and the Cordaitales. We present here at least one of each of the remaining 4 orders, which are as follows:

Gnetales, represented by the Mormon tea bush	p. 87
Cycadales, represented by cycads	p. 87
Ginkgoales, represented by the maidenhair tree	p. 87
Coniferales, represented by a host of plants	pp. 86-97

To most users of this book, the most interesting and important members of this subdivision will be the pines, spruces, hemlocks, and their kin that make up spectacular forests in so many parts of the world. Most of these plants will be trees and at least one of them probably the biggest and possibly the oldest living land plant now to be found on the earth. There are those who contend that some of the giant kelps exceed in length the giant redwoods but the volume of the tree is undoubtedly greater than the volume of the kelp. While it was thought for a long time that the giant redwood represented the oldest and largest land plant, it is now accepted that the Big Tree of Tule in Mexico, *Taxodium mucronatum*, is both older and larger. Its age is at least 5,000 years, or 1,000 years better than the oldest redwood, and its trunk diameter is 50 ft., or 14 ft. greater than the largest redwood. Both trees are, however, gymnosperms.

SUBDIVISION ANGiosPERMAE

FLOWERING PLANTS

Of the 133,500 spermatophytes recognized all but the odd 500 belong to the subdivision Angiospermae. We here attempt to introduce you to about 750 of these. Many of them you no doubt know already since they constitute the greater proportion of the vegetation you are likely to see. Besides this, they supply you with a major portion of the food you eat, the raiment you own, and the buildings in which you live or work.

To the botanist the essential difference between the angiosperms and the more primitive gymnosperms is, as already mentioned, the nature of the enclosure of the seeds. In this group the seeds are enclosed in the pistil while in the gymnosperms they are considered as being naked, even though that it is next to impossible to extract the seeds from the cones of some pines.

Any good botany text will give information on the parts of a flower more satisfactorily than we can develop it here. In our descriptions of the flowers of these plants we have tried to avoid technical terms wherever possible.

The major groups of the angiosperm are the monocotyledons and the dicotyledons, divided primarily on the number of seed leaves to be found in the seeds or showing in the seedlings. These groups are considered in the succeeding pages as follows:

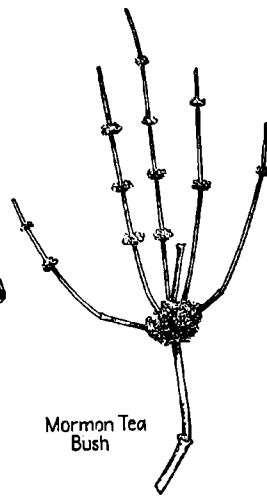
Monocotyledonae	pp. 98-148
Dicotyledoneae.	pp. 149-342



Sago Palm



Maidenhair Tree



Mormon Tea Bush

DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Cycadales
Family Cycadaceae

Sago Palm
Cycas revoluta

Height to 10 ft. Branching or unbranched, with coarse trunk covered by beautiful, recurving, shining, dark-green leaves, 2-7 ft. long whose narrow sections are almost paired opposite each other and end in spine-like tips. Considered as a tree or shrub.

A common conservatory tree in America, grown indoors in the North and outdoors in the South. It favors open areas, is a native of Java, and is grown in subtropical parks and conservatories practically everywhere where suitable temperature may be maintained.

Seed-bearing leaves broad, densely brown-felted, and stiff-tipped. 2 or 3 pairs of seeds are borne at the leaf base. Fruit red, about 1½ in. long and compressed. Seed-bearing cluster of leaves forms a spherical head yielding to 200 seeds about Christmas time. Pollen-bearing leaves make a cylindrical cluster to 20 in. long.

Wood of little importance. The plant is subject to a serious blight whose control is not understood. Its antiquity and its fossil relatives make it well worth knowing.

The plant is grown as an ornamental; the seeds are eaten and used as ornaments by the natives. From the pith of the stem is extracted a powdery starch that is excellent in puddings. The durable leaves are crossed on many a human grave.

Maidenhair Tree
Ginkgo biloba

Height to 80 ft. Straight, slender, with upward-reaching, relatively few branches. Twigs, from which the leaves come in clusters or singly, rather coarse. Leaves to 5 in. long, parallel-veined, usually notched at center of outer edge, pale green.

A native of China and Japan but known as a fossil from Alaska to England to Spitzbergen before it was found alive. Has been growing practically unchanged since the mid-Paleozoic age, where it appears among the first fossil land plants. Darwin called it a "living fossil."

Plants either staminate or pistillate. Staminate catkins slender, stalked and numerous. Pistillate flowers on long stalks, in pairs, develop fruit that smells bad but contains sweet, resinous, edible seeds. Fruit resembles a large, brown, spoiled cherry with a pit that is "off center."

Grows well in any reasonably good soil; is relatively free from insect and fungus injury, is easily propagated by seed, cutting, grafting, or layering. To some, the fruits are poisonous to touch or eat.

Now grown widely as a street and ornamental tree with several horticultural varieties developed to meet certain needs of shape and color. Since the falling fruits make the ground untidy and have an unpleasant odor for some weeks the pistillate tree has lost some of its popularity.

Mormon Tea Bush
Ephedra nevadensis

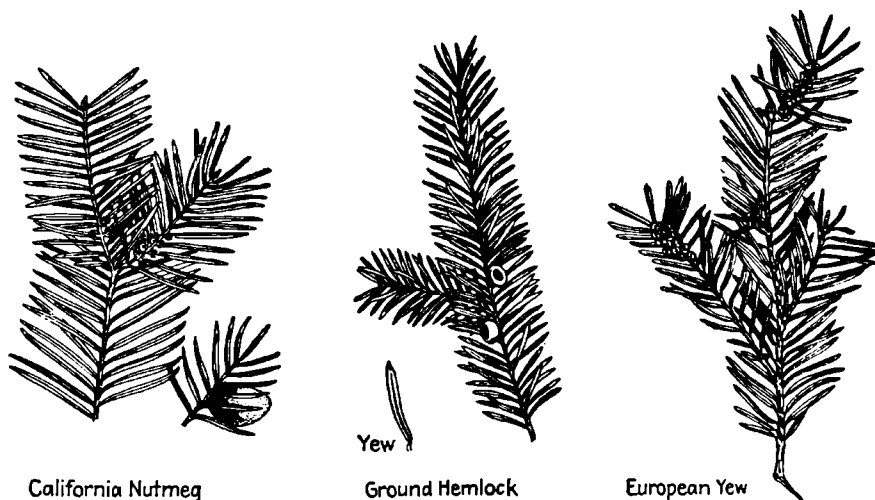
Bushes much branched and densely growing to a height of 5 ft. Branches green. Leaves reduced to length of ⅛ in. in *nevadensis* and to ¼ in. in *trifurca*. Branches look like horsetail (*Equisetum*, p. 84) and the name *Ephedra* refers to this resemblance.

Grows with greasewood (p. 177) and cacti (pp. 268-273) in desert areas from Texas to California and north to Colorado for the two species listed. There are 30 living species of the genus growing in warmer parts of Europe, northern Africa, and tropical America.

Staminate cones of *nevadensis* are 6-8-flowered while those of *trifurca* bear but 1 flower. Pistillate cone of the former, 2-flowered; of *trifurca*, 1-flowered. In each case, the fruit is dry and enclosed in bracts, located at the joints of the stem, with the bract margins in *trifurca* transparent.

Some of the species of the genus are highly ornamental. The plants are not easy to grow where gardens are maintained though they may form a dense thicket in their natural environment.

Of no great significance economically and primarily of interest to botanists. As the name implies, they may have been used as tea substitutes. Also called "Brigham tea."



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE

Order Pinales (Coniferae). CONIFERS

Family Taxaceae. THE YEWS

In Taxaceae considered here, flowers are solitary, axillary; seeds, solitary and usually enclosed in a pulpy berry. They differ from Pinaceae considered on next 9 pages, where flowers are catkin-like, cone-like, or dry and berry-like, enclosing a number of seeds.

California Nutmeg

Torreya californica

Height to 100 ft. Branches spreading, slightly drooping. Bark grayish-brown, with orange tinge on 2-year-old branches. Leaves slender, 1-3½ in. long, shining, dark-green above, pointed, giving off strong, rather clean odor when broken.

This species is essentially a California tree. There are 4 species in North America and Asia. The Japanese *Torreya* is hardiest of all and grows in New England. It has leaves not over 1¼ in. long. Plants favor shaded, sheltered areas with moist soils.

Fruit light green, streaked with brown, about 1-1½ in. long, somewhat cherry-like though larger and the flesh is altogether too thin. Propagated by seeds, by cuttings, and sometimes by grafting on closely related forms; plants raised from cutting may be slow-growing.

Wood hard, strong, exceptionally durable in contact with the soil. It burns long and well and is smooth and close-grained when worked into furniture, tools, ornaments, and other fancy woodwork. It withstands temperature and humidity changes well and is a good general-purpose wood.

In addition to use for wood in Japan, the trees are grown in America as ornamentals. Brilliant greenness of the leaves coupled with artistic shape of young and old trees makes them generally popular. Florida species is known as stinking cedar from odor of crushed leaves.

Ground Hemlock

Taxus canadensis

Low shrubs, rarely over 4 ft. high and usually sprawling in rather dense formations over ground to exclusion of other plants, though in dense shade this may not be so. Leaves usually under 1 in. long; dark-green above, and pale, light green beneath. Twigs rough, dark, and elastic.

Common in evergreen woods from Newfoundland to Virginia and west to Manitoba and Iowa, usually in the shade of other, larger, woody plants. The only native member of the genus in the territory described above and the only species likely to be found in natural areas there.

Flowers in small clusters close to the end of stems, staminate being globular, and pistillate consisting of an erect, seed-like structure that ripens into a beautiful, red, berry-like fruit having a hard nut-like center but is not a true drupe. This fruit ripens about 2 months earlier than that of *T. baccata*, which is planted extensively.

This is a popular shrub for ground cover in shady, steep, stream banks since it serves to hold snow in winter and to hold soil through the year. It also provides excellent year-round cover for small game though its fruits are not wholly useful as food.

A jelly may be made of the soft red part of the fruit, but the seed inside should not be eaten either cooked or raw, as it may have poisonous properties. It is not recommended that the fruit be used as food except in an emergency. Foliage is poisonous to horses and cattle.

European Yew

Taxus baccata

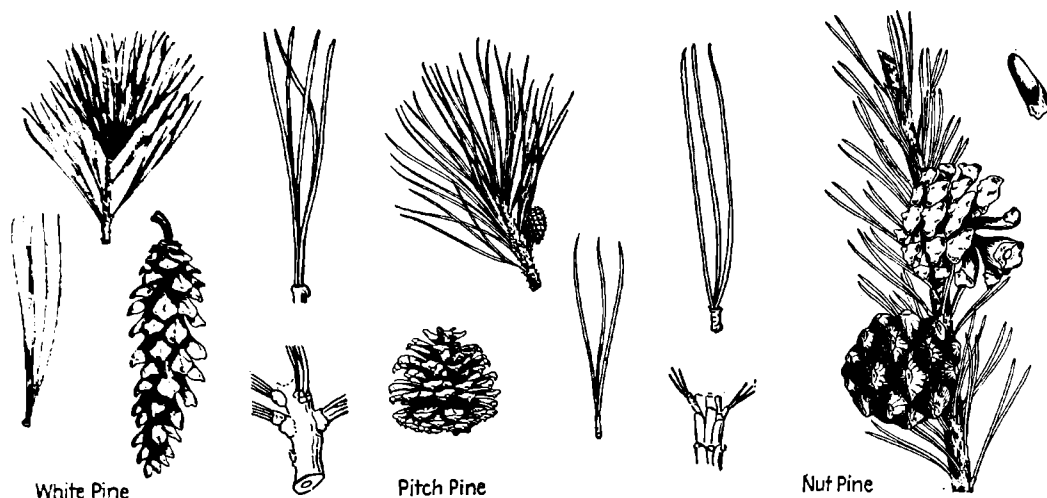
Tree with a height up to 60 ft. and a trunk diameter to over 8 ft. Bark deeply furrowed in old trees; reddish, flaky, and smoother in young. Leaves persistent, dark, shining green above and pale yellowish-green with lighter lines beneath; ¾-1¼ in. long, with some forms being even shorter. Branches droop.

Native of Europe and North Africa east to the Himalayas, but widely established throughout suitable parts of the world as an ornamental. In America, hardy as far north as mid-New England and western New York. In the Far West, the native *T. brevifolia* is found from British Columbia to California.

Fruit ¾-1½ in. across, surrounding on the sides the broad, egg-shaped, brown seed that is only about ¼ in. long. Yew trees are usually either staminate or pistillate, with flowers appearing in early spring and being inconspicuous, followed later in year with brilliant fruits.

Wood hard, strong, durable, uniform, remarkably resistant to weather and suited for maintaining a long fire. The well-known Yule log rolled into the fireplace Christmas Eve gave us the name Yuletide for the season.

The tree finds a greater place in America as an ornamental for hedges and for general landscaping than it does as a source of Christmas firewood. There are many horticultural varieties of shade, color, and other characteristics.



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

White Pine
Pinus strobus

Height to 220 ft. Trunk: in forests, tall, straight, and rarely to 6 ft. in diameter; in open, a rather loose, open tree with graceful, partly drooping branch tips. Bark with shallow, broad-topped ridges, to 2 in. thick. Leaves in clusters of 4-5 needles, each 3-5 in. long, soft, blue-green. Twigs smooth or hairy, fragrant, flexible, resinous.

Newfoundland to Manitoba and south through northern United States and on to Georgia in mountains. Great stands of this tree were in states bordering Great Lakes. Replaced to west by *Pinus monticola*, which ranges through Columbia River Valley in British Columbia south to California. Essentially a tree of hillsides.

Cones: staminate, bright yellow, appearing in late spring in crowded clusters near twig tips just behind new leaves; pistillate, 5-11 in. cones free seeds about second September, though they mature second July. Seeds winged, 26,800 to the pound, with 75-90% normal germination, narrowed at ends, $\frac{1}{4}$ in. long, $\frac{1}{4}$ length of wing, red-brown, with black mortlings.

Wood light, 36% as strong, 22% as hard as white oak; white, uniform, straight-grained, easily worked, and ideal for cabinet work, shingles and walls, masts, and woodenware. White-pine blister rust, with intermediate host on gooseberry, is a serious fungus pest. Beetles attack leading shoot, deforming the tree and making it useless for lumber.

One of the most valuable of trees, the basis of much early prosperity of Great Lakes region. Has been planted rather extensively but less than formerly because of blister rust. A clean stand is beautiful but a wild-life desert. Leaves mildly poisonous to cattle. An old tree is a thing of beauty even though it may be deformed.

Pitch Pine
Pinus rigida

Height to 80 ft. Trunk rugged, bearing horizontal, cone-crowded branches, to 4 ft. in diameter. Bark tough, dark, and broken into irregular fissures which expose plate-like, dark brown to purplish scales. Leaves in 3's, relatively slender and often twisted, 2-5 in. long, frequently yellowish-green, scraggly.

Relatively common on sandy or barren soil from New Brunswick to Lake Ontario and south to northern Georgia and eastern Tennessee. It is sometimes found in cold, deep swamps but does better on exposed rugged terrain frequently along coasts of either fresh or salt waters.

Cones: staminate, at base of new growth, in clusters, yellow or purple; pistillate, clustered or raised on short, stout stems, light-green to purple, developing into stout, persistent cones, 1-3 $\frac{1}{2}$ in. long; mature second fall after pollination but remain on tree indefinitely after triangular $\frac{1}{4}$ -in. thick, $\frac{3}{4}$ -in. long winged seeds are shed; 68,200 seed per lb.; 70-80% germination.

Wood brittle, 32 lb. per cu. ft., light, soft, coarse-grained, durable, light brown to red, not strong, with sapwood that is thick, yellow or white, and relatively soft. A variety, *P. rigida serotina*, pond pine or marsh pine, is found on wetter grounds such as sand flats or even peat swamps.

Used as a tree for poor soils because it is able to resist fire well and yields wood good for firewood, excellent for charcoal, and sometimes suitable for sawing into lumber for coarse construction work. An old tree with its gnarled horizontal branches and its persistent cones is very beautiful.

Nut Pine
Pinus edulis

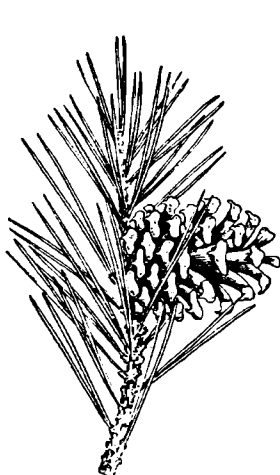
Tree to 40, but more commonly to 20 ft. high, with horizontal, bushy branches when young, low and round-topped when old. Needles 2-3, rigid, dark-green, $\frac{3}{4}$ -1 $\frac{1}{2}$ in. long. Branchlets light yellow-brown. Whole plant almost bush-like in northern part of range.

Colorado to New Mexico and Texas, though may be planted and prove hardy as far north as Massachusetts. One ornamental variety has white leaves mixed in with the green. Normally found on dry hills and slopes within its range.

Cones almost stemless, greenish-yellow, shining, about 1 $\frac{1}{2}$ in. long, with scales strongly keeled or ridged. Seeds about $\frac{1}{2}$ in. long, with a narrow wing that remains attached to scale when separation takes place; sweet and very edible. Pollination by wind.

P. edulis normally distributed at altitudes from 5,000-9,000 ft.; *P. paryana*, another nut pine, or pinyon pine, from 3,500-6,000 ft.; *P. monophylla*, single-leaf pinyon, from 2,000-7,000 ft.; and *P. cembroides*, Mexican pinyon, from 4,500-7,500 ft. All are nut pines.

Nuts of these pines highly important to Indians as food. May be collected by pack rats and the rats' stores robbed by man. Nuts sometimes found in eastern markets. European nut pines, "pinocchi" of Italy, are used in cakes and puddings or as delicacies but have strong turpentine flavor.



Shore or Lodge-pole Pine



Scot's Pine



Mugho Pine

DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

Shore or Lodgepole Pine
Pinus contorta latifolia

Height to 150 ft. Trunk to 3 ft. through, or rarely 6 ft. Branches slender, much forked, light orange when young, and tending to droop. Crown pyramidal to spire-shaped. Leaves in 2's, about 2 in. long but may be 3 in.; around $\frac{3}{4}$ in. through, yellow-green, giving a light appearance.

Commonest cone-bearing tree in northern Rocky Mountains, forming most forests of that area. Ranges from the Yukon south, being found as far south as Lower California at 7,000–11,000 ft. elevations. The common tree through eastern Washington and Oregon, through Yellowstone and Wyoming.

Scrub pine, *P. contorta* has cones with bases more oblique than in this variety. Cones about 2 in. or less long, and may remain closed with seeds still vital for as long as 20 years. On the other hand, cones may open and free seeds as soon as they reach mature size. May produce seeds at 10 years of age, 100,000 per lb.

Wood light, 30% as hard, 40% as strong as white oak, weak, soft, close, straight-grained, light yellow, not durable, with thin, lighter colored sapwood. It is at its best in the Sierra Nevadas of eastern Washington and Oregon and northern California, at elevations between 8,000 and 9,500 ft.

Wood is used for fuel, in rough construction work in mines, as railroad ties, and sometimes made up into coarse lumber. Shearing strength radially, 672; tangentially, 747 lb. per sq. in. Serves as a ground cover in areas where other trees do not thrive.

Scot's Pine
Pinus sylvestris

Tree. Height to 40 ft., normally smaller. Crown pyramidal when young, irregular when old. Bark reddish, red-brown, with thin areas above; dark, thicker areas below. Branchlets dull, gray to yellow. Leaves in 2's, usually twisted, to 3 in. long, bluish green, slender. Buds resinous, brown, oval.

Native of Europe and Siberia, where it has long been under cultivation. Rather extensively planted as a forest tree in early American forestry practice but now not used to any great extent. A great variety of forms characteristic of different areas within range of species.

Cones short-stalked, gray to red-brown, $1\frac{1}{2}$ – $2\frac{1}{2}$ in. long. Seed dark gray, $\frac{3}{4}$ in. long, ripening in early autumn, mottled, 68,400 to a pound, with 70–80% germination; should be collected from October to March and stored in bottles or bags in a cool, dry place until ready for planting in seedbed.

Most important timber tree of Europe. Varieties include slim, tall, red-barked *rigensis*; yellow-coned, slender, pyramidal, broader-leaved *lapponica*; gray-green, thick, stiff-leaved, oblique-coned *engadensis*; columnal, upward-reaching, branched *fastigata*; light, silver-blue-green-leaved *argentea*.

In Europe, it is a timber tree; in America, its greatest use is as a quickly growing cover species and soil anchor. It is relatively free from some common fungus pests but commonly is too irregular in shape to yield timber though it does yield a quick crop of firewood.

Mugho Pine
Pinus mugho

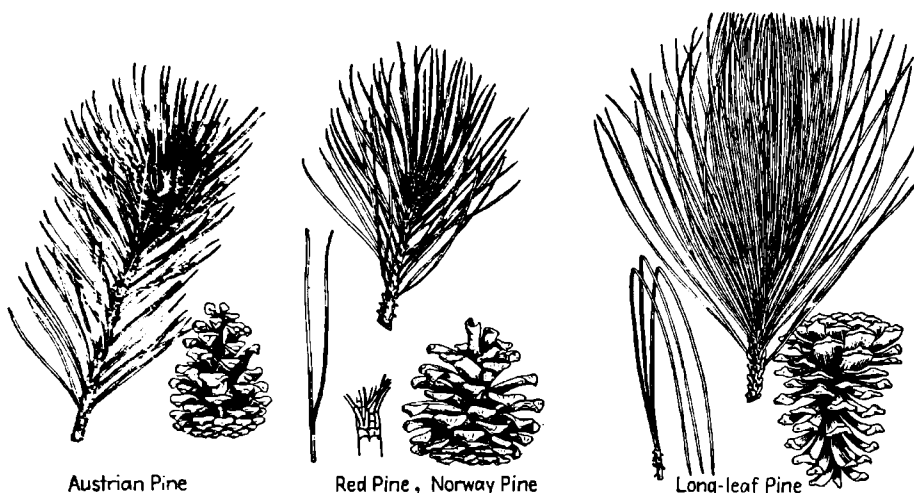
Usually low, spreading, or even prostrate tree, with many branches close to ground, rarely reaching more than 40 ft. in height. Many forms are modified by the surrounding topography. Branchlets brown. Bark dark, rough, and peeling off in flakes. Leaves in 2's, crowded, stout, to $3\frac{1}{2}$ in. long, bright green.

Native of the mountainous areas of central and southern Europe. Four major varieties are recognized: a compact form, *compacta*; a conic form, *rotundata*; a prostrate form, *mugho*; and an oblique, unsymmetrical form, *rostrata*. Other varieties are based on other characters of the leaves, cones, and color.

Young cones usually tawny-yellow, or dark-brown, and shiny; ripen into cones of varying length; in *rostrata*, they are about $2\frac{1}{2}$ in. long, while in some others they are smaller. Varieties and some closely related species frequently cross, so hybrids are abundant and identification is not always easy or accurate.

Possible that prostrate form makes it possible for this species to survive on snow-covered mountains where larger, more erect species could not exist. Except as bizarre ornamentals, the species probably has little commercial value, but landscape gardeners find in it excellent opportunities.

The wood probably would be useful as firewood in areas where other species could not survive, but its commercial value for that purpose would be relatively low.



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

Austrian Pine

Pinus nigra austriaca

Tree. Height to 150 ft. Pyramidal when young, but flat-topped when old, with upward-bending, coarse branches that are relatively stiff. Branchlets light brown, coarsely roughened. Buds light brown, resinous. Leaves in 2's, stiff, coarse, to 7 in. long, dark-green, sometimes slightly twisted, persist about 6 or more years.

Natives of central and southern Europe and Asia Minor, with many varieties, with rather definite geographic limitations. Variety *austriaca* is the commonly planted ornamental in America. It has slightly shorter leaves than the typical species. Other varieties include Crimean, prostrate, Corsican, and so on.

Cones borne near base of new growth of the year; the staminate leaving a relatively bare area when they are shed. Typical cones to 3 in. long, opening to free winged seeds, with opened scales bent far back, usually yellow-brown but darker in interior; slightly varnished on outside. Attractive for ornamental purposes.

Wood relatively uniform, light-colored, highly resinous, rather fast-growing. Relatively free from disease, and when grown with others of its kind makes a dense, dark background useful in establishing windbreaks and in providing some reasonable shelter for game.

Used in America largely as an ornamental and as a windbreak but in Europe is an important timber tree. The variety *austriaca* is hardy farther north than other varieties though most of them can survive as far north as Massachusetts. Possibly more beautiful as young plants than when mature. This enhances their use as ornamentals.

Norway or Red Pine

Pinus resinosa

Height to 100 ft. Trunk straight, tall, to 3 ft. through. Branches stout. Crown broad, open. Bark reddish-brown, shallowly fissured into broad, flat plates. Leaves in clusters of 2's, 4-6 in. long, dark-green, flexible, persistent 3-5 years. Lateral roots stout, rapid-growing, making tree windfirm.

On gravelly ridges, to dry sandy plains. Essentially northern. Nova Scotia and Quebec, south to Pennsylvania, thence west to Minnesota. Locally common. A rather beautiful tree particularly where it grows in pure stands and towers to great heights with uniform straight trunk.

Cones: staminate, $\frac{1}{2}$ in. long, clustered; pistillate, whorled, short-stalked, scarlet. Pollen shed in May. Mature cones conical, closed, with unarmed scales, shedding seeds second autumn. Collect seeds September to October, 61,400 per lb., germination 70-80%. Wind and squirrels spread seeds.

Remarkably free of insect and fungus enemies. Wood resinous, light, hard, 40% as strong as white oak, close-grained, pale red, weighs 30.3 lb. per cu. ft. Twigs stout, light reddish-brown, not downy, roughened near end of each year's growth by leaf stalks. Seedlings $1\frac{1}{4}$ in. high at end of 1 year, with 6-7 cotyledons.

Valuable timber tree, used in heavy construction, for piles and masts. A good substitute for white pine. Bark sometimes used for tanning leather. Often planted in parks as ornamental and probably is most desirable for ornament of all pitch pines which are northern in their range.

Longleaf Pine

Pinus palustris

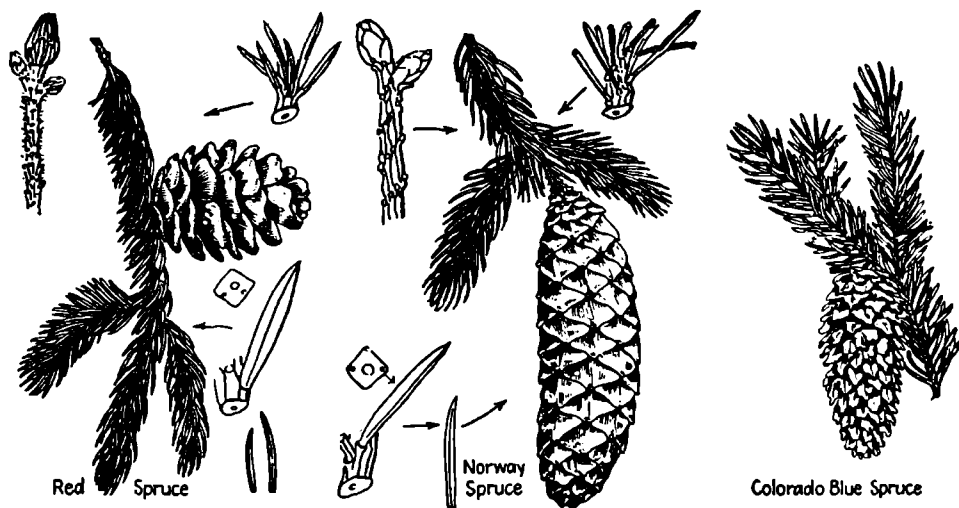
Tree. Height to 120 ft. Trunk tall, straight, tapering, to 3 ft. in diameter, with stout, gnarled, twisted branches. Bark to $\frac{1}{2}$ in. thick, light orange-brown, with thin, papery scales, closely appressed except at surface. Leaves in clusters of 3, dark green, to 18 in. long, dropping off at end of 2nd year.

In areas of sand and gravel, from Virginia to Texas, south through Florida, but mostly in a belt about 125 miles wide from southern Virginia to northern Florida, west to eastern Texas and northern Louisiana. Western yellow pine, *P. ponderosa*, a 3-nedded pine ranging from British Columbia to Mexico and east to South Dakota is also known as long-leaved pine.

New cones appear in early spring in axils of the new leaves; staminate are dark, rose-purple clusters; pistillate appear just below tip of new shoot, in 2's, 3's, or 4's and are also dark purple but develop into 6-10-in. cones, with thin, flat scales bearing $\frac{1}{2}$ -in., ridged, triangular, thin-shelled seeds, on wings $1\frac{1}{4}$ in. long and $\frac{1}{2}$ in. wide.

Wood heavy, 40% as hard, 57% as strong as white oak, durable, pale red to orange, tough, coarse-grained, with winter and summer wood sharply contrasted in color, making wood look streaked. Sapwood thin and nearly white, this being useful in making paper pulp. Whole tree rich in resins, but older trees seem able to resist grass fires remarkably well.

Georgia pine or Southern pine used in making masts, bridges, railway ties, flooring, buildings, fuel, charcoal, and in general heavy construction. Trees under 20 years old may be used in making paper pulp, rayon, and other cellulose materials. This species probably yields a majority of paints and naval stores used in world. Important source of turpentine.



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

Red Spruce
Picea rubens

Tree. Height to 100 ft. Tall, narrow, conical, with branches clear to ground when in the open, or absent when crowded in forest. Trunk to 3 ft. through. Bark to $\frac{1}{2}$ in. thick, with appressed, irregular, red-brown scales. Leaves about $\frac{3}{4}$ in. long, green, square, sharp-tipped, alternate. Twigs brown, hairy, roughened. Buds red-brown.

On dry hillsides and slopes, often being very common. From St. Lawrence River and Prince Edward Island south to Massachusetts coast, inner New England, and south along Appalachian Highland to West Virginia, Tennessee, and North Carolina, at elevations above 2,500 ft. Sometimes found planted as an ornamental.

Cones: staminate, small, oval, bright red; pistillate, oblong cylinders, developing on short, downward-curving stalks into 2-in. cones, with entire or notched scales; cones shed relatively soon after reaching maturity, unlike black spruce in which they persist for many years. Seeds 131,400 per lb., with 59-60% germination.

Wood light, soft, pale, 40% as strong as white oak, close-grained, tinged with red, but with paler sapwood which is usually about 2 in. thick. Among enemies of tree are squirrels, a leaf blister rust, a twig blight, and pecky wood rot. For nurseries, seeds are collected with cones in October and November and stored in a cool dry place.

An important timber tree in Northeast, producing lumber used in flooring, veneer, house construction, sounding boards in musical instruments, paper pulp. Important in airplane construction. Tree yields spruce gum of commerce and twigs yield spruce beer. Too slow-growing for economic reforestation practices.

Norway Spruce
Picea abies

Tree. Height to 150 ft. Straight, cone-shaped, with branches in whorls, extending horizontally from the trunk and rising at the tips, but with numerous short branches hanging from them. Twigs hairy or smooth, brown. Buds with overlapping pointed scales. Old bark with large, thick, flaky scales. Leaves to 1 in. long, sharp-pointed, 4 sided, stalkless.

Grown along roadsides and near buildings. Especially abundant in Norway but widely cultivated from Maine to Washington, D.C., and west to Kansas. It was the tree most farmers of Civil War times planted about their homes for windbreaks and for decoration after they had cut down the native species.

Cones: staminate, among leaves of last year's growth; pistillate, on upper sides of newer branches, at first erect, but when mature during first year, they droop in great clusters. At maturity, cones may be about 6-7 in. long, compact. Seedlings 2 in. tall, with about 4 medium-broad seed leaves. Pollination May; fertilization, June.

Wood white, soft, brittle, weak, 23.8 lb. per cu. ft. Over 30 horticultural varieties recognized, these varying in size, form, color as well as in nature of leaves, twigs, branches, and cones; some being mere prostrate plants with little or no erect trunk, while others are tall, stately trees.

Wood used in oars, spars, masts, paper pulp, baskets, rough construction where great strength is not needed. Trees may grow well and quickly in swampy areas. Relatively few enemies, a bud gall and a few fungi being the worst. These are rarely epidemic and some may remain confined to an individual tree for many years.

Colorado Blue Spruce
Picea pungens

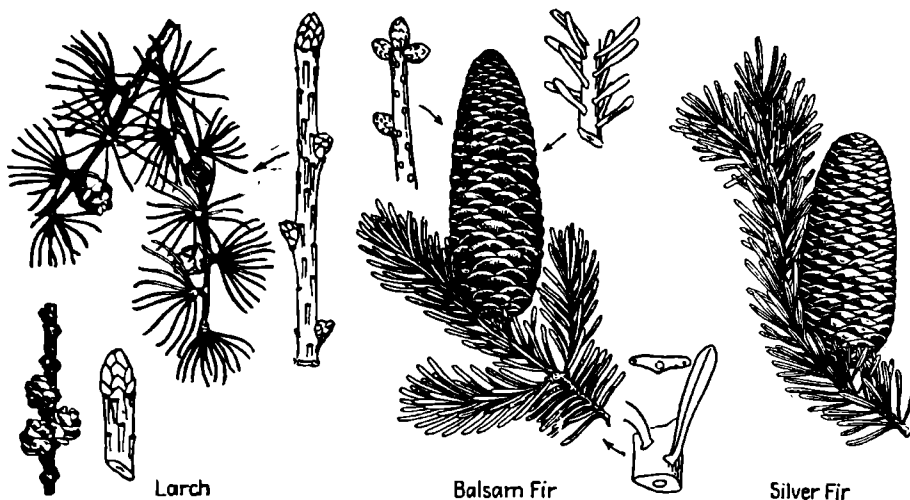
Tree. Height to 150 ft. Trunk to 3 ft. in diameter, but frequently branched into more than one. Relatively low, with stiff, horizontal branches which curve upward near their tips. Twigs roughened by leaf bases. Leaves square in cross section, stiff, sharply pointed, to $1\frac{1}{4}$ in. long, dull blue-green after 3-4 years; lighter, earlier.

Favors stream banks but forms important part of cover in the Wyoming region. Ranges from Colorado, Wyoming, and Utah south to northern New Mexico. Planted extensively as an ornamental, particularly in some of its horticultural forms which are grafted. Normally found wild from 6,500-11,000 ft. elevation.

Cones: staminate, yellow with a tinge of red; pistillate, pale green, with broad scales, developing into 3-in. cones that are found almost exclusively in upper third of tree, are green with a red tinge, and reach full growth by midsummer. Seeds $\frac{3}{8}$ in. long, with wings twice that length, produced in abundance every other year. Tree may live to 600 years.

Wood light, weak, soft, pale brown to white, with negligible sapwood, close-grained, and relatively easily worked. Loss of the lower branches as the tree matures makes it unsightly, particularly if it is grown near other trees, but in youth the trees are most attractive in form and also in color.

Wood has no unique uses and is not superior to that of most other spruces, but tree is one of best of ornamental evergreens and has gained a wide popularity which is deserved. Found favor in Europe as well as in eastern United States for this purpose. Growing season is often under 3 months and trees 6 in. through may be 150 years old.



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

1. American Larch, Tamarack
Larix laricina

2. European Larch
Larix decidua

Height of (1), 60 ft.; of (2), 100 ft. Both pyramidal when young, tending to be more open-topped with age. Branches horizontal, ascending near their tips. Leaves shed in winter; borne in clusters, each a needle about 1 in. long, green, turning yellow in fall.

(2) native through northern and central Europe with close relatives in Siberia. (1) Canada, south to Pennsylvania and Illinois and west to Manitoba. In America, larches are found north to 67° in Siberia, to 72°N. They grow in swamps or on drier lands and are hardy. Western larch reaches height of 200 ft.

Cones of (1), $\frac{1}{2}$ – $\frac{3}{4}$ in. long; of (2), $\frac{3}{4}$ –1 $\frac{1}{2}$ in. Those of (1) may appear more globular than those of (2). Seed of (1) minute, brown, winged with 50–55% germination, shed in autumn and collected for nurseries October to November. Young pistillate flowers of (1) are red. Fastest growth to 40 years; mature at 100–200 years.

Wood 30% as hard, 60% as strong as white oak, durable, heavy, uniform, dark, 32 lb. per cu. ft. Bark of (1), reddish brown; of (2), gray. Will grow on limestone or on acid soils, wet or dry. Usually propagated by seeds sown in spring but can be started by grafts on seedlings, by cuttings of ripened wood or even by layering under glass.

As forest tree that grows farthest north, it is unique. One of best woods for heavy construction where exposure to weather is necessary. Bark contains tannin useful in making leather. Knots strong and fibrous. Is victim of a considerable number of insect and fungus pests. Some ornamental species are popular.

Balsam Fir
Abies balsamea

Tree. Height to 60 ft., though at high altitudes it may be merely a low shrub. Trunk may be to 2 ft. in diameter. Old bark scaly, and spotted with resinous blisters. Twigs smooth, with needle scars scarcely if at all raised. Leaves flat, blunt, narrow needles, $\frac{1}{2}$ –1 $\frac{1}{2}$ in. long, without definite stalks. Buds blunt, resinous.

Variably common in damp woods and swamps from Newfoundland and along highlands to Virginia and west to Iowa and north into Canada. Sometimes planted as an ornamental but not generally so successful as other species of firs nor so hardy as many other conifers that are equally attractive.

Cones erect; the staminate, yellow, tinged with reddish-purple, among the leaves of the preceding year; pistillate, with round, purple scales, with pale green bracts, and developing into 4-in. cones that shed their scales; seeds leave erect cones. Seeds 43,800 to the pound, with 40–60% germination.

Wood white, weak, soft, brittle, 23.8 lb. per cu. ft., weathers poorly, coarse-grained, pale brown to white, with brown streaks and a thick, lighter colored sapwood. Tree seems clean and symmetrical, makes an ideal Christmas decoration because needles are rather long lasting.

Wood used for making weak, poor packing cases, in the making of paper pulp. Bark yields oil of balsam used in medicine and in the arts. Oil commonly used to cement lenses together, to hold cover glasses on microscope slides and for a variety of other purposes. Short-lived, rarely lasting 90 years though some live 150 years.

Silver Fir
Abies concolor

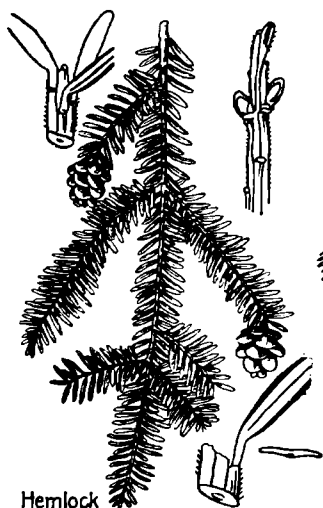
Tree. Height to 250 ft., though inland from the West Coast it rarely exceeds 125 ft. Trunk to 6 ft. in diameter. Bark to 6 in. thick; on old trees, divided into broad, rounded ridges, exposing plate-like scales between. Twigs relatively smooth and rubbery. Leaves flat, slender, crowded, pale blue, to 3 in. long, blunt, dull green after 2 years.

From southern Colorado west to the mountain ranges of California extending north to northern Oregon and south to New Mexico, northern Mexico, and Lower California. A dominant tree in forests in mountains of southern California. Grown as ornamental widely through East and in western Europe.

Cones: staminate, rose to dark red; pistillate, erect, with broad, round scales, developing into mature cones that are to 5 in. long, and only slightly narrowed from the middle to the ends. Cone scales shed, freeing the $\frac{1}{2}$ -in. dark-brown, shining, rose-winged seeds, the wings finally changing to a gray-brown. 11,000 seeds per lb.

Wood 23 lb. per cu. ft. Weak, not durable, coarse-grained, pale brown to white, soft and generally poor, but easily made into weak boxes. This is the big tree of parts of its range and is the only fir to be found in Great Basin in New Mexico and Arizona where it grows in surprisingly dry areas.

A beautiful ornamental tree grown rather extensively for that purpose. Slow grower; a tree 15 in. through may be 150 years old; matures at 250 years. Wood useful only in making such things as cheap packing cases, though it has been used in making butter tubs, and other wooden containers which do not require great strength.



Hemlock



Douglas Spruce or Fir



Norfolk Island Pine

DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

Hemlock

Tsuga canadensis

Tree. Height to 100 ft. Tall, straight, pyramid-like, variable in form. Trunk to 4 ft. in diameter, gradually tapering. Bark to $\frac{3}{4}$ in. thick, deeply cut, with narrow grooves and rounded, somewhat scaly ridges, dark-gray or reddish. Buds blunt, brown, $\frac{1}{8}$ in. long. Leaves flat, to $\frac{3}{8}$ in. long, $\frac{1}{16}$ in. wide, with 2 light lines beneath.

Common, mostly on upland ridges or scattered through broad-leaved forests. Very common gorge tree, not common in open. Nova Scotia to Minnesota and south to Alabama and Tennessee. Replaced to the west by three other species, with black or mountain hemlock of the West being the most different.

Cones: staminate, small, pale yellow; pistillate, pale green at first, but developing into $\frac{3}{4}$ -in. cones which open late in first winter and free minute, winged seeds in which wings are about twice length of seed. Seeds 200,000 per lb. with 20-30% germination.

Wood light, 20 lb. per cu. ft., 58% as strong, 33% as hard as white oak, "brash," with unpleasant smell particularly when wet, splits easily and splinters on weathering, does not work easily, light brown with a tinge of red, with sapwood thin and somewhat darker. Cones shed at end of first year and leaves usually at end of their third year.

Wood used for coarse construction, particularly where it will not be exposed to weather. Inner bark has strong astringent qualities, yields most of materials formerly used in tanning leather in Northeast and Canada. Whole forests in Adirondacks were cut down for bark alone. Hemlock oil is extracted from young branches. Tea made from leaves.

Douglas Spruce or Douglas Fir

Pseudotsuga taxifolia

Tree. Height to over 200 ft. Trunk tall, straight, to 12 ft. in diameter. Bark on young trees, smooth, thin, gray; on old trees, to 1 ft. thick, broken into oblong plates or great rounded ridges, with the outer surfaces showing pressed scales. Buds pointed, $\frac{1}{4}$ in. long. Leaves flat, pointed, to $1\frac{1}{4}$ in. long by $\frac{1}{16}$ in. wide.

In the Rocky Mountains from latitude 55° N., south to northern Mexico but reaches greatest size in British Columbia, Washington, Oregon region where it is the "big tree." It is planted extensively as an ornamental through the East and in temperate Europe. Can survive a wide range of climatic conditions.

Cones: staminate, orange-red, small; pistillate, slender, with a touch of red, developing into mature cones, to 6 $\frac{1}{2}$ in. long, bearing unique scales, with longer "cover scales." Cones hang down in attractive clusters and reach maturity by midsummer. Seeds $\frac{1}{4}$ in. long and half as wide, with dark-brown wings that are also about $\frac{1}{2}$ in. long.

Wood 25 lb. per cu. ft., remarkably uniform, 40% as hard, 50% as strong as white oak, light, yellow to red, with white sapwood that varies greatly in depth. Branchlets pale orange and shining the first season, turning successively red-brown and gray, and fuzzy for 3-4 years. Leaves may persist for as long as 16 years. Bark of old trees resists fire reasonably well.

Wood used for all sorts of construction, for buildings, railway ties, telephone poles, piles, and for fuel. It is the Oregon pine of commerce. Bark is sometimes used as a source of material for tanning leather and, in East, plant is used for hedges, windbreaks, and ornamental purposes. Tea made of leaves.

Norfolk Island Pine

Araucaria excelsa

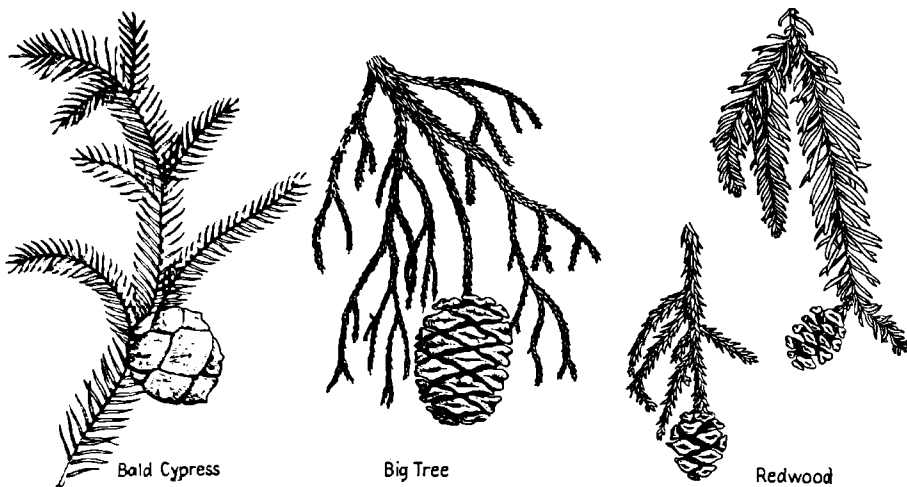
Height in native land, to 200 ft., with trunk 10 ft. in diameter. Most commonly known in America as a hothouse or house plant. General form a central stem with well-separated whorls of horizontal branches that bear needles on secondary branches, or drooping branchlets. Needles about $\frac{1}{2}$ in. long, densely crowded on the stems.

Native of Norfolk Island between New Caledonia and New Zealand but grown as a house plant almost anywhere. The related *A. imbricata* is a tree grown as an ornamental in America and hardy along our West Coast to Washington and in Florida on the East Coast. There are large evergreen tree species in the genus in South America and Australia.

Cones large, woody globes, about 5 in. in diameter, with a seed under each scale, with the staminate and pistillate cones separate. Greenhouse and house plants are usually raised from seeds, the plants having market value when 2-3 layers of branches have been developed. Also grown from cuttings from leader shoots in beheaded plants.

Wood in large trees is used in ship-building because of strength, durability, and workability. In spite of the fact that araucarias grow in warmer parts of the world, they do best where night temperatures are not above 60°F. and where they are not exposed too long to a direct summer sun.

The use as house plants testifies to their beauty. In Florida and the West Coast areas, araucarias are valuable as ornamentals in landscaping.



Bald Cypress

Big Tree

Redwood

DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE

Order Coniferales. Family Pinaceae

Bald Cypress

Taxodium distichum

Height to 150 ft. Trunk to over 12 ft., with great buttresses increasing this dimension; usually hollow in old age. Leaves shed annually, about $\frac{3}{4}$ in. long, flat, thin, narrow, light green, and borne like the parts of a feather on the branchlets that are sometimes shed with the leaves.

In swamps, for most part from Delaware to Florida and west to Texas to elevation of 1,750 ft., and Missouri, usually where water is strong with lime but sometimes planted successfully on high dry land. 90% is at under 100 ft. elevation. Related Montezuma cypress of Mexico is planted in southern California and may have a trunk 20 ft. in diameter.

Cones: staminate, in loose, 4-in., purple clusters; pistillate, like roughened 1-in. spheres. Pollen shed in March to May. Seeds $\frac{1}{4}$ in. long, winged and 2 to a scale, 5,000 to a pound, 40% germination, planted in early spring for nurseries, or cuttings are started in sand saturated with water or in water alone.

Buttress roots serve to provide a broad base for a large tree anchored on a soft soil and to play a role in getting air to submerged parts during time of year when roots are water-covered. Trees in drier soils are more slender pyramids than broad trees growing in swamps.

Wood 64% as strong as white oak, 30% as hard, close-grained, durable "wood eternal," used for cabinet work, interior decoration, and other places where strength is not important; 28 lb. per cu. ft. Basis of important lumber industry. A few fine stands are being preserved in parks. Maximum age 800 years. Second-growth 100-year tree is 100 ft. high, with 20-in. trunk.

Big Tree

Sequoia gigantea

Height to 280 ft. Trunk to 35 ft. in diameter. Bark darker, richer brown, than in the redwood and known to resist a 7-day fire of logs, to 2 ft. thick. Leaves scale-like, blue-green, $\frac{3}{8}$ - $\frac{1}{2}$ in. long, with longer leaves on the larger twigs, and the longest on the seedlings. Tree might weigh 6,000 tons.

In Central California, between 5,000 and 8,500 ft., elevation on the west side of the Sierra, usually in groves of which some 28 are considered important. The best developed groves are to be found on north fork of Tule River in California with extensive forests in King's River country.

Cones 2-3 $\frac{3}{4}$ in. long by 1 $\frac{3}{8}$ -2 $\frac{1}{4}$ in. thick, with 4-6 seeds, each $\frac{1}{4}$ - $\frac{1}{4}$ in. long, under each scale. Seeds shed when mature in the second summer; about 3,000 seeds to the ounce. In nature, only about 1 seed in a million germinates and a small percentage of these take root. Reproduces only by seed. Seeds fertile to 20 years.

Wood 20 lb. per cu. ft., weak, brittle, coarse-grained, becoming dark on exposure. Tree known to live between 4,000 and 5,000 years, though it is doubtful if any over 4,000 are now standing. None known to have died of old age and no reason why tree should not live to 10,000 or more years. Annual growing season 30 days to 6 months.

Undoubtedly, oldest living thing in United States is a big tree. Some authorities believe that there are older trees of other species in Mexico and in other parts of world. Big trees have fallen to ax to make commonplace shingles, fences, and toolsheds.

Redwood

Sequoia sempervirens

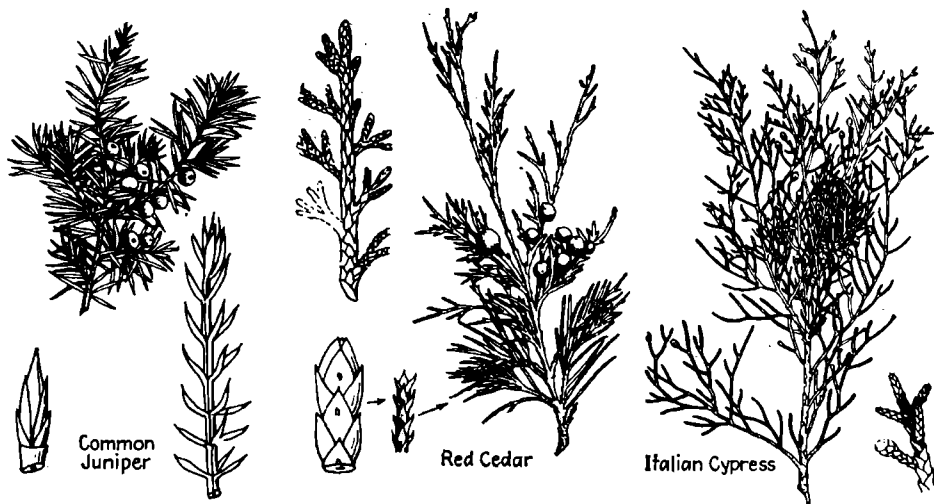
Tree. Height to 364 ft. Diameter, breast high, to nearly 18 ft. Bark lighter in color than in big tree, to over 1 ft. thick, widely furrowed and ridged at the base. Needles flat, stiff, borne singly and not scale-like as in big tree; $\frac{3}{8}$ -1 in. long, unequal in length, sharp-pointed; whitish beneath and dark above.

From sea level to 3,000 ft. elevations, in a 450-mile strip in fog belt of western California and Oregon, never growing naturally out of this fog belt region extending from Chetco River in southern Oregon to Monterey County, California. Never naturally over 30 miles from Pacific Ocean in this area; usually in groves.

Cones only $\frac{3}{4}$ -1 in. long with 4-5 seeds under each cone scale. Cones mature in 1 year. Seeds thin and flat. Reproduces either from seed or from stumps of older trees. Redwood 350 ft. high, with a 20-ft. trunk is about 1,000 years old. Oldest of the trees known is 1,400 years old.

Wood light, 67% as strong as white oak, 20 lb. per cu. ft., light red, durable close to the soil, easily worked and split, close-grained. "Founder's Tree," in Bull Creek Flat, near Dyerville, Calif., is estimated to contain 235,000 board feet of timber. It has a circumference of 72 ft. at ground and is 345 ft. high.

Fortunately some of finer redwoods are now being preserved in national and other parks in West. Pure forests of smaller trees yield tremendous amounts of lumber. One tree yielded 480,000 board feet excluding waste. Smaller trees frequently raised as ornamentals, both in Europe and in America. Leaves yield a perfume. Burls make ornaments.



DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE
Order Coniferales. Family Pinaceae

Common Juniper
Juniperus communis

Tree erect or sprawling shrub. Up to 40 ft. high, but usually much lower. Leaves needle-shaped, joined in whorls at base and with a broad, whitish band on top, very sharp-pointed; $\frac{1}{2}$ – $\frac{3}{4}$ in. long, standing out from the stem in young plants and being more scale-like in older plants.

Ranges through North America, Europe, and Asia, circumpolar; in eastern United States sometimes forming dense prickly thickets. Among close relatives are Colorado juniper of the foothills of the Rockies; California or desert juniper, of the desert basins; Sierra juniper of the rocky ridges of the West up to 11,000 ft. elevation.

Flowers in axils of leaves, with the pistillate and staminate cones on different plants. Fruit almost stemless, dark-blue, from $\frac{1}{4}$ – $\frac{1}{2}$ in. through, with a bloom that rubs off easily. Berry-like fruit is really a fleshy cone that bears seeds hidden within; flesh however is not succulent.

Most commonly found junipers are those used as ornamentals and these are not tall but chosen for their form or color. Among common forms are narrow, columnar Irish juniper with its short leaves; the Swedish juniper that grows to a 40-ft. slender spire; the 2-ft. high, spreading mountain juniper and the 4-ft. prostrate juniper.

Junipers besides being ornamental provide excellent shelter and some food for game, and are excellent soil anchors on steep slopes. They are propagated by seeds that germinate in the second or third year, though this may be hurried by dipping for under 6 seconds in boiling water. See also red cedar. Oil from wood and leaves of some species used in perfumes and medicines. Bad forage.

Red Cedar
Juniperus virginiana

Tree. Height to 120 ft. Commonly appears as shrub or pyramid-shaped tree, usually with many branching trunks rather than a single central trunk. Bark shreddy. Trunk to 4 ft. in diameter. Leaves mostly opposite, somewhat triangular in outline, with tip free from or pressed to twig, crowded. Twigs: usually 4-sided, with covering of leaves.

Common from dry hills or dense swamps ranging from Nova Scotia to Ontario and North Dakota, south to Kansas and Florida. More commonly grows mixed with other species than in a pure stand, though pure stands sometimes do occur in limited areas. Growth is slow, maximum age about 300 years. Seedlings appear second year after seeds are planted.

Staminate and pistillate cone-like structures are on different trees, clustered near the tips of the twigs. When young, they appear cone-like, but as the pistillate cones mature, they become bluish, berry-like structures, $\frac{1}{4}$ in. through, each with 1–3 seeds. Pollination in April or May. Mature berries or cones shed after first winter.

Wood heartwood, fragrant, hard, uniform in texture, very durable, 30.7 lb. per cu. ft., very red but streaked with yellow or brown, takes a brilliant polish; beautiful when varnished. Birds carry seeds. Tree is host to cedar-apple disease fungus that makes a scab on apples. Bagworms also are pests.

Wood most useful in making chests and certain kinds of furniture, for making cedar closets which are relatively free of moth attacks. Posts are exceptionally durable. Oil from leaves and from wood used in perfumes and in arts. Decoction of fruits is used as tea and medicinally. Grown as ornamental but should not be planted near apples. Bark is good under.

True Cypress (Italian)
Cupressus sempervirens

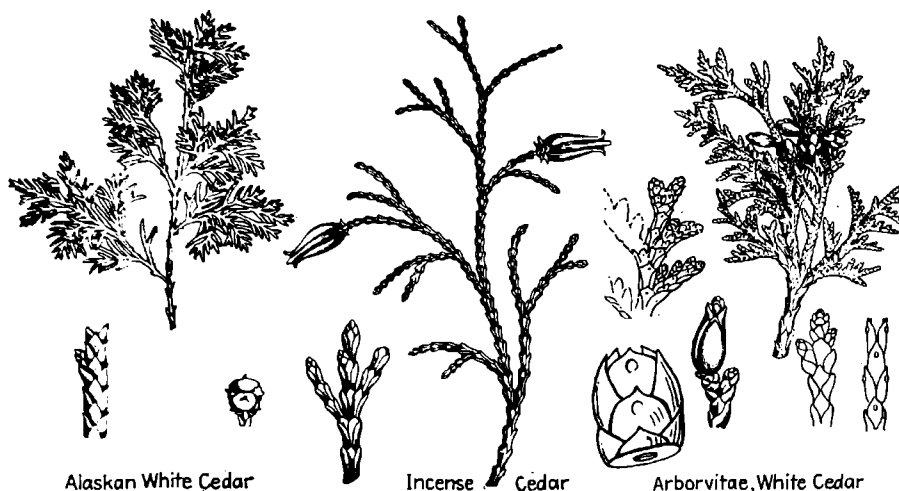
C. sempervirens Italian cypress is an 80-ft. tree, with thin, gray bark and erect or horizontal branches. Monterey cypress has dark reddish-brown bark. Leaves of former, $\frac{1}{2}$ in. long; of latter, $\frac{1}{16}$ in. long; of both, closely appressed to the branchlets and usually dark or bright green.

Italian cypress is a native of Southern Europe and western Asia and is famous in some Italian plantings. Classical cypress of the Roman and Greek writers of old. Monterey cypress is native of the Bay of Monterey in California.

Cones of the two cypresses described above between 1 and $1\frac{1}{2}$ in. across, with usually 8–12 scales, though there may be 2 more in the Italian cypress. In nurseries, cypresses are grown from seeds, being transplanted frequently in the early stages to develop a ball-like root system. Otherwise they do not transplant well.

These plants are essentially of interest because of their beauty and their botanically unique characters. Some species are grown as far north as regions of light frosts but California and Gulf States seem to mark northern limits in United States. Hardest are Arizona cypress and the two mentioned above.

Arizona cypress reaches sufficient size to yield an excellent timber that has the usual properties of its close relatives. Most of the other species do not grow large enough, are too rare, or too subject to frost killing to be of much economic importance.



Alaskan White Cedar

Incense Cedar

Arborvitae White Cedar

DIVISION IV. SPERMATOPHYTA. SUBDIVISION GYMNOSPERMAE

Order Coniferales. Family Pinaceae

1. Alaska White Cedar *Coamaecyparis thyoides*

2. Alaskan Cypress *C. nootkatensis*

(1), tree to 80 ft. high; with reddish-brown bark, fissured into flat, connected ridges; and with inner bark that may be torn into long, strong strips. Branchlets flattened. Leaves with gland on back. (2), tree to 120 ft. high; with gray-brown bark, separated on surface into large, loose scales, and irregular fissures. Branchlets not flattened but squarish. Leaf backs glandless.

6 species of genus in North America and eastern Asia. (1) Ranges from Maine to Florida and west to Mississippi, being found mostly in swamps. (2) Ranges from Alaska to northern California, and in cultivation, in California and through the East; from sea level to 3,000 ft. elevations, at higher elevations appearing like a low shrub.

Cones: of (1), about $\frac{3}{4}$ in. across, bluish-purple; of (2), nearly $\frac{1}{2}$ in. across, and dark reddish-brown. 1 or 2 winged seeds under each fertile scale, each with wings as broad as the dark, red-brown body; and whole, about $\frac{1}{8}$ in. long. Seeds wind-borne, shed over a relatively long period of time, and produce 2-coryledoned seedlings.

(1), favors wet areas; produces a light, soft, weak, close-grained, light-brown to reddish, fragrant, uniform wood. (2), produces a hard, close-grained, brittle, durable, bright-yellow, fragrant wood with resinous quality, with a very thin, white sapwood. This tree lends itself well to cultivation and is commonly grown as an ornamental.

(1), wood is used in boat building, shingles, interior finish, fenceposts, railway ties, cabinet work, and woodware. (2), wood is used in furniture, shipbuilding, and interior finish. Inner bark of either may be used as fiber of a primitive nature, particularly in making baskets that will hold water.

Incense Cedar *Libocedrus decurrens*

Tree. Height 200 ft. Branches erect and relatively short, forming a beautiful, narrow pyramid, with bright green foliage. Leaves oblong, close to bright green, flattened branchlets, free at tips and pointed but most conspicuous because of base that grows to branchlet. Bark bright, cinnamon. Young trees conspicuous because of bright green color.

Ranges from Lower California to Nevada and Oregon but grown in other areas as ornamentals and in arboreta. 8 species to be found in western North and South America, in southern and western China, and in Australia. Closely related to genus *Thuja* including white cedar that has more numerous cone scales, with 2 pairs bearing seeds.

Cones $\frac{3}{4}$ –1 in. long, light red-brown, of 6 woody scales, one pair of which bears 2 seeds with long wings; staminate and pistillate, on different trees. Seeds planted in spring or plants may be reproduced by cutting made in late summer and rooted under glass. Whips may also be grafted on *Thuja* stock or on Alaska white cedar. Seeds abundant every 2–3 years.

Wood light, soft, 60% as strong as white oak, unusually durable in contact with soil, close-grained, straight-grained, easily worked, slightly and pleasantly fragrant, 22 lb. per cu. ft. Hardy farther north than most species. Does best in open, well-drained soils. Because trees lose their lower branches early, young trees are favored in landscaping.

Wood used in shipbuilding, in fenceposts, in interior cabinet work, for shingles and sidings of houses. Trees probably are as important to horticulturalists who use them as ornamentals as to foresters who might wish timber. Matures at about 300 years but may live to 500. Tree 200 years old, 90 ft. high with 30 in. trunk; 400 years, 110 ft. high, 40 in. trunk.

Arbor Vitae. White Cedar *Thuja occidentalis*

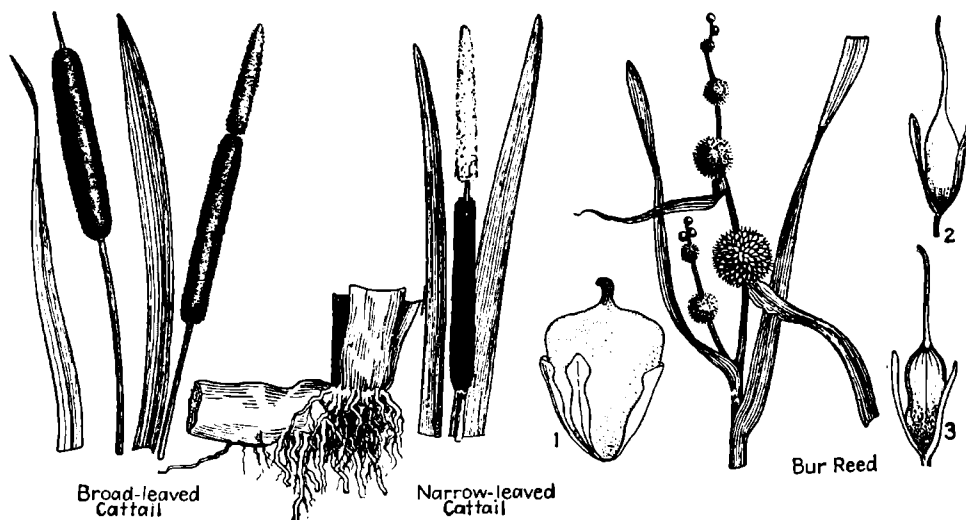
Tree. Height to 70 ft. Cylindrical to cone-shaped, but variously shaped. Trunk to 5 ft. through. Bark pale, shredding vertically into long strips, free at the ends and curling free from trunk. Leaves flat, opposite, closely pressed to twigs, alternating with pairs of folded needles, also closely pressed to twigs.

Common, particularly in swampy areas, in cool spots from eastern Quebec to Pennsylvania, along the mountains to North Carolina and west to Minnesota and Manitoba. Often forms almost impenetrable forests but usually where there is an abundance of ground water, size of trees being larger in northern part of range.

New cones form in April and May from liver-colored cones, the staminate and pistillate being on different branches of the same tree. Mature cones $\frac{1}{2}$ in. long, with thin, woody scales, and ready by early fall to shed $\frac{1}{8}$ -in. seeds with thin wings that are as wide as the seed itself. 325,000 seeds per lb.

Wood soft, 33% as strong as white oak, very durable, brittle, coarse-grained, 19.7 lb. per cu. ft., fragrant, yellowish or pale brown, and relatively easily worked for certain purposes. Seedlings about 4 in. tall, with spreading, narrow leaves, in 2's and 4's. Nurseries have produced a tremendous number of varying forms.

Wood used as lumber, in making shingles, spools, boats, railroad ties, and for other woodware. Bark may be shredded for tinder. In an open fire, the wood "spits" sparks and crackles loudly but is not so dangerous in spreading forest fires as some hardwoods. Extracts from the younger branchlets yield medicinal substances. Maximum age about 300 years.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Pandanales

Family Typhaceae

Common Cattail
Typha latifolia

Height to 6 ft. or more. Leaves alternate, narrow, ribbon-shaped, to nearly 1 in. wide, or as narrow as $\frac{1}{4}$ in., sheathing the stem, filled with large air cells. Rootstock horizontal, branching, 2-3 in. thick, white within, well-stocked with starch, and forming a firm floor about at usual water line.

Found in marshlands throughout temperate North America, Europe, and Asia with next species continuing the range into tropical areas. Often forms extensive, clear stands giving characteristic appearance to surroundings. About 17 species in tropical and temperate areas.

Flower stalk to height of over 8 ft.; ends in 2 flowering spikes, uppermost is staminate, with loose stamens that are shed in early summer; lower, pistillate. Pistillate and staminate areas not separated by bare portion as in next species.

Cattail marshes provide superior shelter for waterfowl but little food. As a result, in marsh management it is often necessary to cut bayous that increase the shore line accessible to birds that must get their food in more open waters.

General use similar to that outlined in next species though this one provides superior leaves for calking barrels and for making rush-bottomed furniture. Fluffy fruits of both species are used for stuffing pillows and insulating blankets. Young stems, up to 18 in., minus rind are delicious. Young fruits eaten as "Cossack asparagus." Roots eaten as salad.

Narrow-leaved Cattail
Typha angustifolia

Height to 6 ft. Leaves erect, flat, smooth, green ribbons, about $\frac{1}{2}$ in. broad as contrasted with inch-wide leaves of broad-leaved cattail. Underground a stout, horizontal, perennial rootstock well-stocked with starch, branching and giving rise to leaves and flower stalks.

Native of Eurasia and other north temperate parts of world. Found from southern Maine to North Carolina and west to the Pacific Coast, but most abundant near coast. Has more restricted range than broadleaved cattail and is rarely so abundant. Both grow in shallow waters or marshlands.

Flowers appear in early summer, either pistillate or staminate. The two are borne on same erect stalk with staminate at top and separated slightly from pistillate, a character which helps distinguish the two species. Pollen wind-carried. Fruits wind-carried when spikes break during winter or following spring. Seedlings grass-like.

Erect leaves expose maximum surface to sun when it is at angle; minimum surface when it is strongest or directly above. Creeping rootstocks submerged for considerable portion of year, particularly when fire may sweep exposed upper portions. Underground parts provide good food for muskrats, and upper parts summer protection.

Leaves of this and of broad-leaved cattail may be cut in late summer, dried either on racks or in shooks, and twisted or braided into cords, which may be used in making rush-bottomed furniture. Staminate heads, harvested at their prime, yield a flour-like nutritious powder, submerged rootstocks, a starchy food, and plants, flood control.

Family Sparganiaceae

Burreed
Sparganium sp.

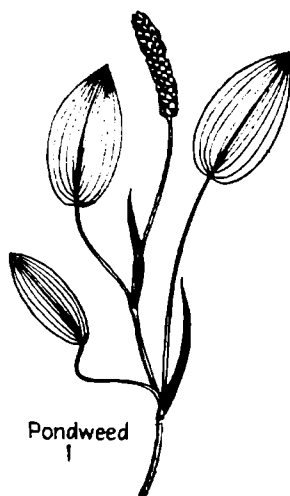
Up to 5 ft. high, of rosettes of long, erect, limp, or partly surface-floating, flat, keeled or 3-sided leaves, with fruiting stems either erect or limp. Identified largely by fruit clusters. Important species: (1), *S. eurycarpum*; (2), *americanum*; (3), *chlorocarpum*; (4), *angustifolium*; (5), *multipedunculatum*.

Found in marshes, along the margins of still or slowly moving bodies of water. Various species occupy all southern Canada and United States, except states bordering Mexico but including California. (1), widest spread.

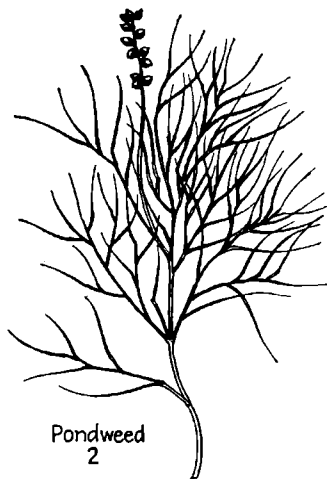
Fruiting stem bears at and near tip spheres of staminate flowers that shed pollen into wind for lower spheres of pistillate flowers. These in (1) are close to flowering stem. Fruits of (1), with 2 stigmas. Nutlets (1), triangular, egg-shaped; (2), slender spindle; (3), tight-belted spindle; (4), broad spindle. Perennial.

Plant serves as anchor for soil in wave-beaten or river-flooded flats and as food for many birds, mammals, and insects. Some of plants may be tuber-bearing and supply extra food through these. (1) may favor lime while (4) may favor acid. Transplanted by seeds or rootstocks.

All species provide superior cover and favored food for muskrats, preferred food for deer, and good food and cover for waterfowl, the last eating nutlets and tubers. Of the species mentioned, (1) is probably most important to wildlife.



Pondweed
1



Pondweed
2



Pondweed
3

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Najadales. Family Najadaceae

Floating-leaved Pondweed

Potamogeton natans

Stems unbranched or only slightly branched. Leaves of 2 kinds: floating type has the blade base slightly heart-shaped, to 4 in. long and 2 in. wide, with petioles; 0.1 in. thick and stipules to 4 in. long; submerged leaves slender, soon die and are shed, with late-season ones even smaller.

Widely distributed over world in temperate and subtropical regions in ponds and slowly moving streams. Tolerant of acid. Best at depths of 1-5 ft. Many related species with floating leaves, of which at least 16 are described in Gray's "Manual" for the East.

Flowers of most pondweeds are borne in slender spikes that extend well above the water surface in quiet weather. Some if not all flowers may be pollinated by wind. Spikes and their fruits are drawn below the surface at maturity.

Important as a duck food since rootstocks and nutlets are available late in season in great abundance. Because these nutlets are held late, this species outranks some others in importance in managing ponds for wildlife production. Propagated by seeds and rootstocks.

Unique shape has appealed to artists, and its leaves and weak stems provide an almost standard motif for artists interested in representing the environment in which the plants live. It may have some food and fertilizer value. Cuttings for stocking are dropped in clay balls every 6 ft., or 3-5 bushels an acre.

Sago Pondweed

Potamogeton pectinatus

Stem almost thread-like and repeatedly branching into 2. Leaves exceedingly narrow and bristle-like with points tapering but sides parallel for most part. Stipules joined to base of leaf making a sheath for stem. Tubers borne on horizontal stem at base of plant.

Does best in water 2½-5 or more ft. deep, over sandy mud, in fresh or up to even 44% sea water. Most important aquatic in alkaline lakes of the West. Ranges from Quebec to British Columbia, south to Florida and Mexico. Whole plant is normally submerged.

Fruit with short beak, borne in spikes of 2-6 rather well-separated whorls; each fruit about ⅓ in. long, compressed, rounded on back, poorly ridged on sides. Tubers reasonably abundant on horizontal part of plant that is just beneath soil surface. Seeds require 1 bushel an acre or a handful broadcast at 9 ft. intervals.

This species is listed as most important of all the pondweeds for encouragement of ducks, which feed freely and abundantly on nutlets that constitute an important part of fruit and on tubers at base of plant. Its wide range also makes it of importance to migrants.

Can be reproduced by transplanting underground rootstock and tuber-like buds; 1,200 to an acre or slips at 6-ft. intervals. If dried in windrows, seeds may remain viable for as long as a year. Tubers harvested in spring with dip nets can be shipped wet for transplanting if water is changed and temperature is kept down.

Pondweed

Potamogeton crispus

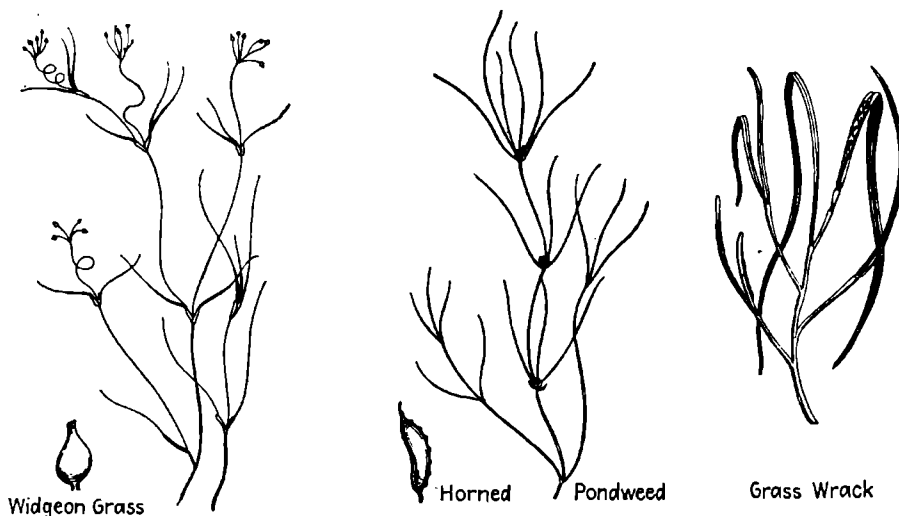
Stem compressed and weak. Leaves with margins, finely toothed, with sides not parallel, but usually wavy-margined. Related whitestem muskie weed, *P. praelongus*, has boat-shaped leaf tip, and persistent stipules. Bassweed or clasping stem pondweed, *P. Richardsonii*, has greatly reduced stipules.

P. crispus found in hard, or brackish water, often where it is polluted; introduced from Europe. Common from Massachusetts to Ontario and Virginia. *P. Richardsonii*, from Quebec to British Columbia and south to New England and Nebraska. *P. praelongus*, from Nova Scotia to British Columbia, New Jersey, and Mexico.

Chief means of propagation of *P. crispus* is by bur-like winter buds formed by hardened short branches grown into leaf bases. Fruits in spikes, ripen in June and July, but whole flower cluster is relatively inconspicuous. When fresh, fruits have a soft portion.

Eaten by ducks but may become a bad weed in ponds where water is polluted. Closely related *P. Richardsonii* is reported more frequently as a duck food but this may be due to nature of its range. Winter buds of most of the pondweeds make a staple food for ducks.

Provides food and shelter for game of various sorts. While such game fish as bass and muskallunge do not feed on the weeds, they find in them shelter and smaller food which does eat them. Ducks may eat these species because they are abundant. Most do best in clear water 6-8 ft. deep.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Najadales. Family Najadaceae

Widgeon Grass
Ruppia maritima

Stems thread-like, forking, bearing even more thread-like alternate leaves, that sheath stems at base. *R. occidentalis* is a large form found in alkaline and saline lakes in the interior. Leaves of *R. maritima*, 4-5 in. long; of *occidentalis* 3-4 times that length.

Found in shallow bays along entire coast to a point where salinity is only 2% normal sea water. It can live in fresh water or in a salinity half again that of normal sea water. *R. maritima* and *R. occidentalis* occupy almost any saline or alkaline waterways in the United States.

Normal propagation is by seeds or vegetative portions. Seeds of *R. maritima* much like those of sage pondweed but are smaller, black, pointed, and borne in slender-stalked clusters. Cuttings do not normally begin to root unless they are in contact with soil.

Considered excellent duck food because of seeds and vegetative portions, both of which are eaten, but it is important in this respect only in areas where water is brackish or alkaline. Since it is more tolerant to these conditions than many other aquatics, it is uniquely useful.

Seeds of this and related plants are planted in spring or after normal crops are harvested in late summer or fall. Fall planting is usually preferred because it uses stock that has not been stored so long and is therefore more likely to be virile. Spring planting avoids destruction by migrating birds.

Horned Pondweed
Zannichellia palustris

Stems numerous, thread-like, from extensive, creeping rootstocks. Leaves are opposite and frequently bunched closely together and are narrower, longer, and less crowded than in *Najas*. Stipules sheathing and membrane-like.

Found from the north edge of the Gulf of St. Lawrence west to the Yukon Territory and south into Mexico, being abundant all over the United States. Does best on good soil in fresh spring-fed water and in water up to 40% normal sea-water salinity.

Fruits flattened and usually toothed down one side, borne in axils of the leaves in groups of 2-5 and show a distinct, horn-like form; are short-stalked or stalkless, with a body up to 0.1 in. long, with one variety with a slightly longer fruit.

Fruits and much of plant parts are eaten readily and with profit by most waterfowl. It has been reported in the diet of black duck, gadwall, mallard, pintail, redhead, ringneck, bluebill, shoveler, blue-winged teal, cinnamon teal, and widgeon.

In wildlife management, plants are propagated by distributing seeds or vegetative parts of plants into new territory. It is not difficult to find or to transplant.

Grass Wrack, Eel Grass
Zostera marina

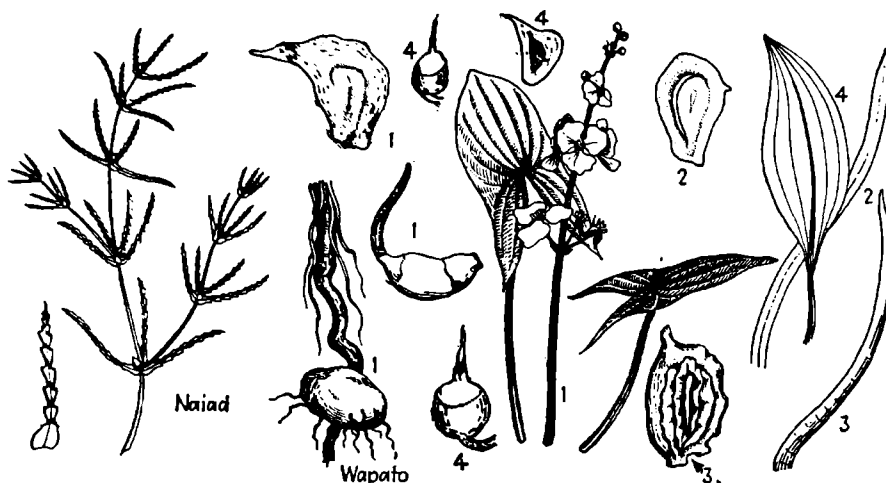
Stem jointed, creeping, wholly submerged, sheathed by bases of long, slender, blunt-ended, ribbon-like, 3-5-nerved, flat leaves whose margins are not notched or irregular like those of the otherwise generally similar leaves of *Valisneria*, even though those notched are fine and often overlooked.

Usually submerged in 2-6 ft. of water, in brackish water up to 25% that of normal sea water, and where the water is relatively cool. It is found in one variety or another along both coasts of the United States but not the Gulf Coast, and north to South Carolina.

Reproduction in nature or under management is normally either by seeds or by rootstocks. Flowers are either staminate or pistillate and only one kind is found on a given plant.

Seeds and vegetative portions provide superior food for waterfowl in brackish and saline waters. Along Atlantic Coast, it has been attacked by a fungus that has greatly reduced its abundance. Measures are being taken to supplant it there with a West Coast variety that may be disease-resistant.

Importance of this plant in salty waters is such that efforts will be made to save it from complete destruction or to supplant it with other species or varieties that may be equally useful.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Najadales

Family Najadaceae

Bushy or Northern Naiad
Naiad flexilis

Stems very slender, often branched into 2 parts. Leaves opposite, slender to thread-like, and commonly crowded into whorls formed usually at a fork in the stem; slightly wider at base but leaf tapers before it widens at base.

Commonest representative of genus in northern half of United States and southern Canada, extending north to central Hudson Bay and Yukon Territory and south to Florida and south central California, except for most of Texas, Colorado, Utah, Nevada, and south. Most abundant in Great Lakes area.

Frut to $\frac{1}{4}$ in. long, narrowly oblong, with seeds that are slender ovals and smooth and shining; located in axils of leaves rather than in clusters as in pondweeds. New plants may be propagated by separating larger plants and rooting cuttings.

Naiads can grow at depths of 20 ft. or more, apparently with less light than most other seed plants of water, in fresh or brackish water. This species is most commonly found growing over sandy bottoms with wild celery. Most naiads are at their best in water 1-4 ft. deep.

This is probably most useful of all duck foods, nutlets and vegetative parts being eaten regularly and developing in such a way that large flocks of waterfowl may be maintained without injury to the forage.

Wapato, Water Nut, Swamp Potato

1. *Sagittaria latifolia*
2. *Sagittaria graminea*

Height to over 3 ft. Leaves like broad spearheads, coarse, dark-green, varying greatly with depth of water (1); slender, spear-like (2). Tubers size of a potato, twice as long as broad, with slender point (1); smaller (2).

(1), at fresh-water margins from southern Canada throughout most of United States and sometimes almost completely submerged. (2), mostly submerged in shallow mud-bottomed marshes, streams, and ponds from Newfoundland to Florida, Saskatchewan to Texas.

Flowers produced in summer, on erect stems, white, with parts in whorls of 3 with 3 petals and 3 sepals surrounding crowded nutlets whose beaks in (1) are horizontal and incurved and in (2) incurved and remarkably short. Both are flattened and partially winged.

Mostly perennial, milky-juiced, succulent plants with variable leaf shapes. Water loss through leaves is great and therefore in some reservoirs plants are eliminated to help save water. Tubers of (1) may rival size of ordinary cultivated potatoes.

Both fruits and tubers are eaten by waterfowl and the tubers by muskrats. 16 species of ducks and geese are known to feed on the plants, which are commonly set out where it is desired that ducks should be attracted. Common names also include Indian onion, wild onion, and duck potato.

Family Alismaceae

3. Dwarf Wapato
Sagittaria teres

4. Delta Duck Potato
Sagittaria platyphylla

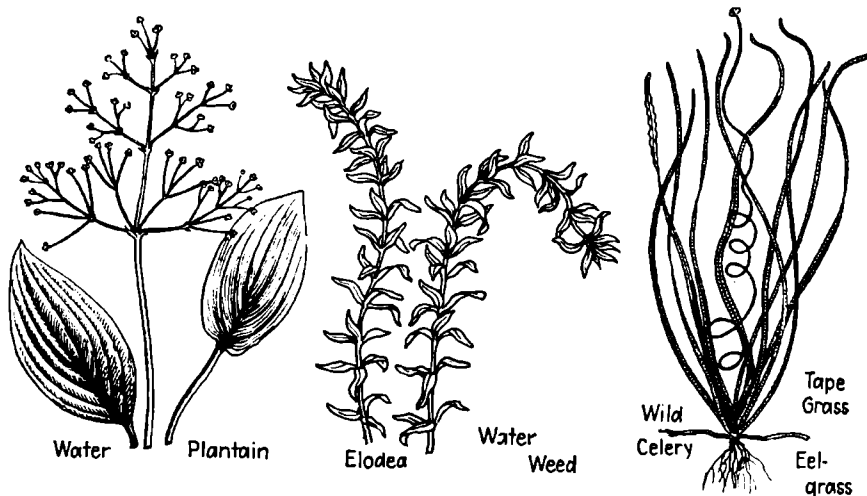
Plants only a few inches high with leaves usually slender throughout their length (3), or plants to over 1 ft. high with leaves on slender petioles with expanded blade at tip (4). Tubers of (3), small spheres about the size of BB shot; of (4), to nearly 1 in. through.

Found in mud flats in very shallow water from Massachusetts to Florida (3) and in marshes that are either fresh or with brackish water from Alabama to Texas and north to Missouri, Kansas, and Tennessee in (4).

In each of these species, flowers are either pistillate or staminate and both are borne on same plant. In (4), stems bearing fruits bend backward at maturity, but not in (3). Fruits of (3) have a very short, erect beak while in (4) beak is not erect.

Some persons consider shape of leaves of (4) indicative of saltiness of water in which plants grow. In (3), waterfowl commonly feed on whole plants while in (4) only the tubers may be selected. In neither case are the fruits important food.

Tubers of (4) have been found in stomachs of gadwalls, ring-necked ducks, pintails, mallards, canvasbacks, and pheasants. One canvasback alone had 36 tubers in its stomach and gizzard, some as much as 1 in. in diameter. Obviously, this is an important duck food, particularly in the South.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Najadales

Family Alismaceae

Water Plantain

Alisma plantago-aquatica

Height to over 2 ft. Leaves in rosettes, with long petioles for, on the average, over half the length and broad-pointed, egg-shaped, coarse-veined blades or if submerged, no blades or these simply ribbon-like. Related species, *A. gramineum* (2), commonly narrower bladed.

Found in marshes and wet spots, from British Columbia to California, Florida to Nova Scotia, with *A. gramineum* widespread in Europe, Asia, and Africa.

Flowers small, on ends of slender, branching, stiff structures. In *A. plantago-aquatica*, petals are white; in *gramineum*, pink. Nutlets crowded in fruits with 2 ridges and a groove down back; in (1), 3 ridges and in (2), 2 grooves. Perennial and maintained through winter and adverse conditions by a stout underground corm, which can divide and produce new units.

Must have water in abundance at some time to grow and may survive submergence for a long time.

Not an important plant in marshes or for game species. Small quantities of nutlets have been reported as entering diet of wild ducks and of pheasants, but never in significant quantities. Ducks concerned include 12 species.

Waterweed, Elodea

Anacharis canadensis

Stems weak, long, not profusely branched but crowded throughout most of length with leaves about $\frac{1}{2}$ in. long, with minutely irregular margins; not broadened at base as in naiads. Will grow unrooted or will root on ground contact.

Found across the continent, from Gulf of St. Lawrence to southern British Columbia, except northern Maine, and south to central California and South Carolina. Generally favors fresh water over mucky bottoms at various depths.

Pistillate flowers borne on long, slender stems that reach to water surface. Some flowers with stamens and pistils. Fruit small and oblong, with few seeds. Commonest method of reproduction, breaking of plants and starting of new ones from fragments. Fruits never abundant.

Plants grow so readily and root so quickly that they may become really water weeds. In England and Europe, often serious water pests. Ducks feed on fruits and leaves, one redhead having been found with 600 fruits filling half its stomach.

Plants are sometimes fed to domestic and captive ducks as a greenstuff since they grow so quickly, but should not be introduced where more desirable species exist. Leaves used in studying cell structure and protoplasm movement in biology classes.

Family Hydrocharitaceae

Wild Celery, Tape Grass

Vallisneria spiralis

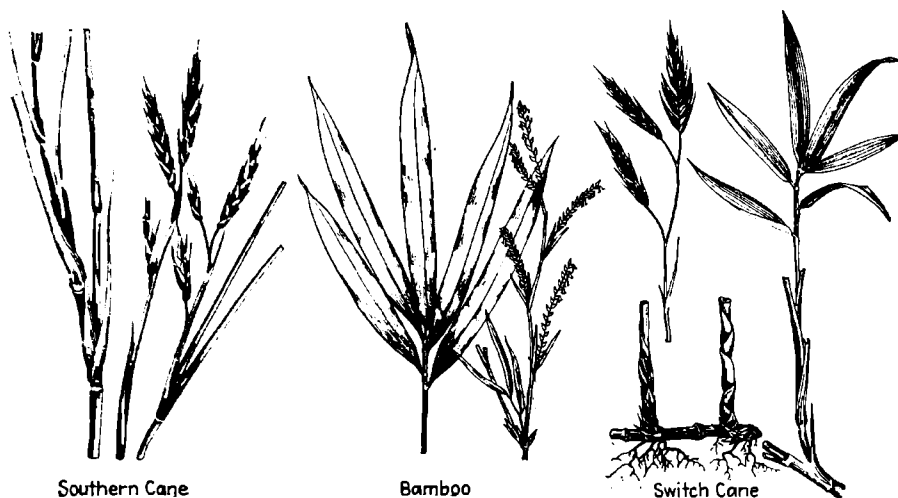
Stems buried in the mud but producing tufts and clusters of leaves like slender, pale-green ribbons. Common names, tape grass and eel grass, suggest leaf type. Stem roots freely at joints and new buds are delicious.

Found from Nova Scotia to North Dakota and south to Florida and Louisiana, but not in all parts of lower Mississippi Valley. Common in spring-fed lakes and streams, submerged in water from 1-3 or more ft. deep, and in water of salinity up to 28‰ normal sea water in growing season.

Staminate flowers break loose and rise to surface, floating to pistillate flowers that float at surface at end of slender, long stem. After pollination, pistils and maturing fruit are drawn down by a spiral development of supporting stem.

In North, mature fruits found from September to November; in South, they mature in late December. Fruits, leaves, and more particularly underground buds provide one of best duck foods for ducks and for those who may eat the ducks that have fed on wild celery.

Wild celery is transplanted in wildlife management by using seeds, winter buds, or portions of rootstocks. Plants are eaten by fish, muskrats, and all sorts of waterfowl and are probably not exceeded in their food value by any other aquatic plant. They are propagated relatively easily.



Southern Cane

Bamboo

Switch Cane

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Southern Cane

Arundinaria gigantea

Height to 30 ft., with numerous, short, spreading branches. Arise from stout, underground rhizomes. Erect stems only sparingly branched the first year, but very leafy and branched the second. Leaves 4-8 in. long and to $1\frac{1}{2}$ in. wide, smooth or fuzzy, with persistent sheaths.

Native in the United States, being found from Virginia to southern Ohio and Illinois, south to Florida and Texas and being cultivated as an ornamental elsewhere. The plants sometime form almost pure stands, making the well-known cane brakes of the South that often are extensive in lowlands.

Flowering branchlets are on main, erect stems appearing second year or later. Spikelets of 8-12 flowers, to 3 in. long, springing in clusters commonly from forks from which side branches come. Stems that have borne fruits soon die.

Favors rich lowlands along rivers, with plants flowering simultaneously over great areas at irregular but frequent intervals. Erect stems or culms may be as much as 3 in. through, hard and strong, and make an impenetrable barrier to traffic since they grow crowded closely together.

Young shoots make excellent forage for cattle. Leaves and seeds favored by cattle. Shoots frequently canned and may be purchased in groceries. Stems used in fish poles, pipes, baskets, mats, trinkets, fences, floors, rafts, and to some extent in buildings.

Japanese Bamboo

Arundinaria japonica

Height to 10 ft. Erect stems arising from underground rhizomes are greenish or golden, stiff and tough, and bear single branches from the axils of the leaves. Leaves to 10 in. or more long and to 2 in. wide, smooth, shining above, and whitish or fuzzy beneath, with conspicuous sheaths.

As the name implies, this is a native of Japan but it is grown extensively in parks and gardens in the South as an ornamental. It is particularly popular in cities because of its general hardness.

Flowers borne in rather open, spike-like clusters that spring from the axils of the leaves. In closely related *A. Simonii*, also from Japan, flowers appear very frequently and erect stems do not then die down as is the case with many other arundinarias, such as the native southern cane.

Bamboos are among the most rapidly growing of all plants, some species increasing as much as 18 in. in height in a single day. Some species, not American, may reach a height of 100 ft. or more and may form almost impenetrable jungles because of the closegrowing, tremendously hard stems.

This species is of interest to us because of its hardness and its ornamental beauty. Some species yield materials useful in making of paper and textiles. Uniformity, lightness, and strength of stems makes them ideal for construction of temporary houses, bridges, and rafts.

Switch Cane

Arundinaria tecta

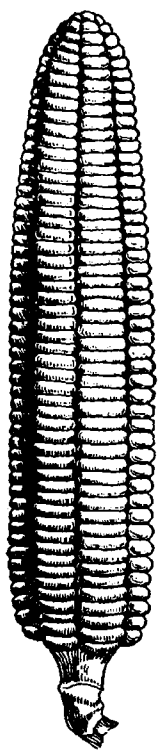
Height to 12 ft. but more commonly not over 6. Arise from stout, horizontal rhizomes. Erect stems slender, stiff, and bear leaves that are rough and to 6 in. long. In one variety, the leaves are shed each fall, the leaves turning yellow and new ones appearing each spring.

Found in swamps and moist soil from Maryland to southern Indiana and to the south and west through southern Oklahoma and Louisiana. This and the southern cane are the only native bamboos of the United States, but others are found frequently grown as ornamentals in various parts.

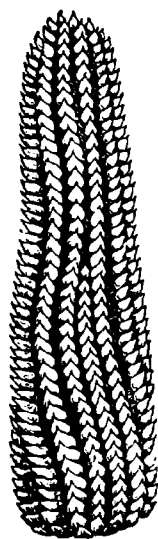
Flowers are borne in clusters near tips of leafless or almost leafless shoots that grow from the base of the plant or seem to arise independently from hidden or creeping rhizomes. Reproduction is either by seeds or by breaking up of underground parts.

Shoots, leaves, and younger stems are all eaten by cattle and hogs. In fact, hogs grub out and eat great quantities of underground portions of the plant. Dense crowding of stems provides an excellent shelter for many kinds of game and so plants are valuable both for food and shelter.

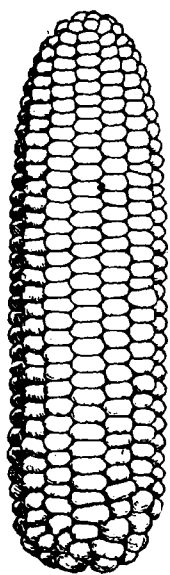
These plants are too small for uses commonly made of other bamboos, but small canes, trinkets, and some kinds of furniture are not infrequently made of erect stems. Branching rhizomes provide a good soil anchor in flooded places and so prevent soil loss. Hogs may eradicate the plants.



Flint Corn



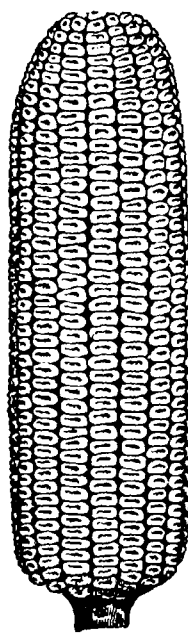
Pop Corn



Sweet Corn



Corn



Dent Corn

PHYLUM SPERMATOPHYTES. CLASS MONOCOTYLEDONEAE

Order Graminales. Family Gramineae

Flint Corn

Zea mays v. indurata

Height to 12 ft. or more, with stems; coarse, succulent. Leaves large, mature, relatively early, and reasonably hardy and strong. Root systems sometimes deep.

Native of America. Flint corn is grown for grain farther north than are the different kinds of dent corn. It requires a deep, rich, sandy loam, with humus and sufficient water for best results.

Annual. Flowers in general, as in other corns. Ears long, slender, generally yellow-brown when mature. Favored varieties, Hall's gold nugget and King Philip. Kernels smooth, hard on top, closely crowded on relatively slender cob. Seed to harvest, about 90-100 days.

Kernels planted in hills or rows. If in hills, about 3-5 are planted in hills about 3½ ft. apart, to a depth of 1-2 in. If planted in rows, there should be about 1 plant to every foot of the row. Planting should be made after danger of frost. Cultivation as with other kinds of corn. In the East, stalks are harvested for ensilage.

As food for man, kernel is fair as a muscle builder (protein); excellent as a blood builder (iron) and as a maker of energy (carbohydrate); fair for bones and nerves (calcium and phosphorus). Fair for vitamin A and good for vitamin B. In West may be eaten by cattle in fields. Ears are picked when mature and stored.

Sweet Corn

Zea mays v. saccharata

Height to around 8 ft., intermediate between pop corn and dent corn. Leaves clasping at the base, curving downward. Roots fibrous, with special prop roots near ground.

Native of America. Common trade varieties, golden bantam and Crosby evergreen. For early crops, favors well-drained sandy loams; for late crops, a richer, water-holding type.

Annual. Staminate flowers in tassels at top of plant. Pollen wind-blown to "silk" or tip of pistils in "ear" lower on plant. Mature ear 5-8 in. long. Mature kernel yellow, wrinkled, horny, more or less translucent. Immature kernel soft, milky, sweet, edible. Seed to harvest, 90-100 days. Kernel an achene.

Kernels planted in hills 3 ft. apart, 3-4 per hill, 1-2 in. deep, after frost danger. Planting at 2-week intervals prolongs harvest. Cultivate at least 4 times when soil is dry; first deep, then shallow after roots develop. Animal enemies include grasshoppers, earworms (in South), wireworms; plant enemy, corn smut.

Sweet corn is a fair energy builder for man and cattle; fair source of calcium and phosphorus for bones and nerves. Used to make alcohol, syrups, gums, starches, and oils from fruits. Ton of corn yields about 90 gal. of alcohol for explosives, fuel, and other uses. Paper from stalks, explosives, from pith, special charcoal from cobs.

Pop Corn

Zea mays v. everta

Height to 6-7 ft., but usually the shortest of the corns. Leaves smaller than in the other kinds of corn. Roots in general similar to type already described.

Native of America but now grown farther north than was the original corn plant. Soil requirements in general similar to those of sweet corn.

Annual. Flowers in general similar to those of sweet corn. Number of ears to a stalk may be a hereditary character. Mature ear 5-8 in. long, relatively slender. Kernel, when ripe, hard, smooth, sharp-tipped, and crowded into many rows. Hard surface essential to good "popping." Seed to harvest, 90-100 days.

Kernels are planted in hills or rows, 3 ft. apart. About 5 kernels to a hill, to depth of 1-2 in., after frost danger. Cultivate as with other kinds of corn. Pop corn should not be harvested until the kernels are mature but before danger of frost. Keep in well-aired, cool, dry place. Animal enemies much the same as for sweet corn.

As food for man, pop corn is essentially a producer of starches that provide the usual carbohydrate parts of a diet. Pop corn is not normally fed to cattle, although the vegetative part of the plant has some silage value. Curworms that work at night cut plants off close to the ground. Plant enemy, corn smut.

Dent Corn

Zea mays v. indentata

Height commonly well over 12 ft., with coarse, succulent leaves and stems that are excellent for ensilage and good strong, sometimes deep root systems that can combat drought.

Native of America. This is the important corn of the Corn Belt and the backbone of the hog and cattle industry. It does best on the deep, rich soils of the long-season Middle West.

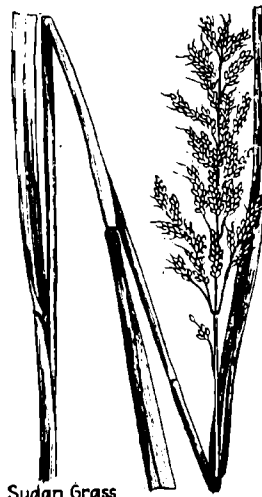
Annual. Flowers in general like other corn flowers. Ears relatively short and thick, with cob proportionately small but actually large. Kernel indented on the top, yellow, white or red. Requires 145 days or more from seed to harvest.

Kernels are planted in hills or rows. If in hills, 3½ ft. apart. About 4-7 qt. will plant an acre. Planted in rows about 1 ft. apart. Planting after frost danger. For about a quarter of a century, the average yield per acre in the United States was between 25 and 30 bushels. Depends upon man to develop disease-resistant strains.

It is not sound economics on a nation-wide basis to feed corn to hogs, but it pays the farmers of the Corn Belt. As food for man dent corn is essentially like flint corn, although the volume of dent corn is much the larger.



Johnson Grass



Sudan Grass



Broom Corn

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Graminales. Family Gramineae

Johnson Grass

Holcus halepensis

Height to 7 ft. With tough, persistent, creeping, sheathing rootstocks. Stems $\frac{1}{2}$ in. thick, smooth and leafy. Leaves smooth, with roughened edges, conspicuous midribs, 1 ft. or more long and $\frac{1}{2}$ -1 in. wide. Generally vigorous in appearance. Except for perennial rootstock, plant resembles sorghum.

Native of southern Europe and Asia but now all too firmly established in Southern states and elsewhere. Introduced into United States about 1830 by Governor William Johnson of Alabama and Governor Means of South Carolina, with thought that it might provide a superior pasture and hay grass.

Flowering panicle open, spreading, to 2 ft. long, with 2-3 branches at a joint, and more or less drooping. Spikelets in pairs at joints, or in 3's at ends, each containing one flower that produces a fruit. Grain free, closely resembles sorghum grain. Spikelets usually awnless. Blooms in June, and July.

Thrives on great variety of soils, rich or poor, wet or dry. Does not grow during drought but grows rapidly immediately after rains. Rarely persists where ground freezes to 6 in. Yields 2-4 crops of hay a year which, if cut young, is palatable and nutritious. Does not stand grazing well. Sow 1-1 $\frac{1}{2}$ bushels per acre.

Eradication by prevention of seeding, by pasturing a year or two then plowing to depth of 3-4 in. to expose roots to frost, by disking in early summer and then planting to a crop such as cotton that is cultivated, or cowpeas that smother with dense growth. May be poisonous to cattle in dry weather. Hogs relish rootstocks.

Sudan Grass

Holcus sudanensis

Height to 10 ft., exceeding the similar Tunis grass *H. virgatus*. Leaves many, up to $\frac{1}{2}$ in. wide. In general much like Johnson grass but without perennial, spreading, tough rootstocks that make it a pest. Narrower leaves provide an easy superficial identification character.

First coming from South Africa and becoming established as a crop grass in the limited rainfall of our area north to central Kansas. The related Rhodes grass of central Africa does well in the dry soil of the southern part of the Gulf States.

Fruiting and flowering cluster of Sudan grass about 1 ft. long and half as wide; that of Tunis grass, 2 ft. or more long and slender. In both, spikelets bear awns for the most part and both are annuals. In Sudan grass, spikelets are usually brown; in Tunis grass, green.

Sudan grass has ornamental possibilities, but its greatest value lies in its forage properties. Being an annual, it yields well to crop rotation practices and while the amount of forage produced may not equal that of Johnson grass, the quality is better and the plant may be kept in control more easily.

It is possible that this plant may prove of increasing value as a crop in areas where water is not sufficiently abundant to support more common crop plants. It probably does not play an important part in wildlife management but does give a quick hay crop when this is needed.

Broom Corn

Holcus sorghum v. technicus

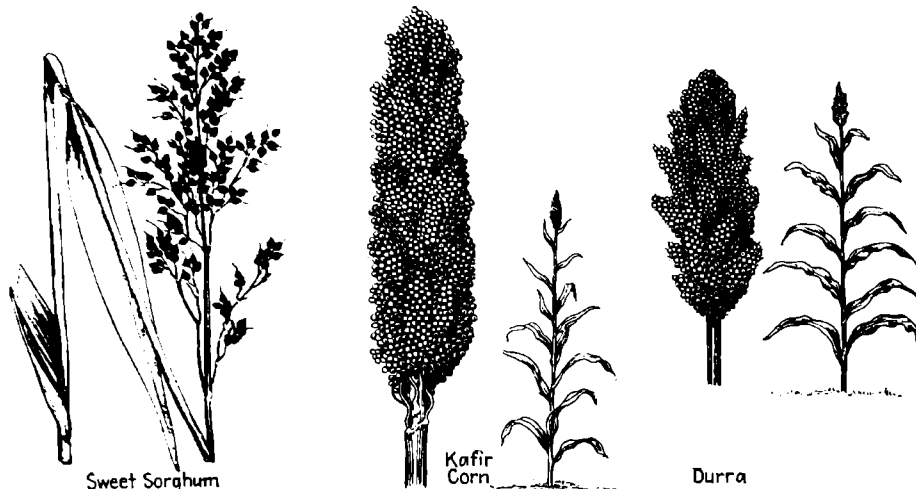
Two varieties include standard, with a height up to 15 ft.; and dwarf, with a height up to 7 ft. Stems solid and tough. Root system in general, similar to that of corn, but more likely to be deep-rooted.

Native of tropical Asia and Africa. Grown extensively in Europe, for the most part in Italy, Austria, Hungary, and Germany. In America, standard is commonly grown in Illinois and adjacent states; dwarf, in Oklahoma, Kansas, and Texas. Requires a fertile soil and abundant moisture. Grown in United States since 1797.

In standard, the "brush" or flower panicle is 18-30 in. long, slender and flexible; in dwarf, 1-2 ft. long and much stiffer and broader. Rays or branches of panicle or brush are naked below, stiff, and arise from almost a common point but branch at the ends. Spikelets awned.

Standard is planted in rows 3 $\frac{1}{2}$ ft. apart, with the plants 3 in. apart; dwarf, in rows 3 ft. apart with plants 2 in. apart. From 3-5 lb. of seed are used to plant an acre. In harvesting standard, tops of two rows are bent toward each other to form a "table" 2 $\frac{1}{2}$ ft. up.

Raised for the brush, useful in making brooms. A crop of dwarf should yield 400-500 lb. to the acre. It is sold in bales of 300-400 lb. of material, cured in layers to 3 in. deep after the seeds have been threshed out.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Sweet Sorghum

Holcus sorghum v. *vulgaris*

Height to 15 ft. Leaves numerous, and broader than in most of its close relatives. Stem coarse, pithy, and well-supplied with a sweet juice; conspicuously jointed. Root system much like that of corn, but may be more branching to form a continuous, shallow, underground mat.

Native of Africa and southern Asia; introduced into America probably about 1875 for serious culture. Among leading cultivated forms are amber and orange. It has been developed from same species that produced broom corn, durra, and kafir corn. It is important in the South and Southwest. Grown in Egypt before 2200 B.C.

Flowers are borne in terminal, loose, drooping panicles, with spikelets showing protruding red or yellowish-red fruits from between dark-red or black enclosing scales. Amber matures early; orange, later; gooseneck and redtop, later. Black amber matures in 85-90 days; red amber, 90-100; orange sorgho, 110-115.

Seed is planted in drills much like corn; when it is in rows, must be closer. Broadcast seeding requires 75-100 lb. (1½-2 bushels) to the acre; close rows, uncultivated, 50-75 lb.; wide rows cultivated, 8-20 lb. It may be planted after corn and yield of forage is higher than with corn.

Raised for fodder, for ensilage, as a smother crop, for a fermented drink, for production of syrup. Sugar production from sorghum is possible but too expensive. As pasturage, is dangerous after frost as poisonous properties may develop. These disappear when plant is cured for storage as fodder. Sought as winter food by ducks in some localities.

Kafir Corn

Holcus sorghum v. *caffrorum*

Some grain sorghums may grow to height of 15 ft. Kaffirs are stout, with somewhat juicy stems, crowded leaves, with juice almost sour. Milo sorghum is less leafy than kafir. Feterita, another variety, reaches a height of 14 ft. and is either slender or stout, by some classed as a durra. (Hegari is the variety shown.)

Kafir and most grain sorghums are native of Africa, but kafir is probably most commonly grown variety in United States. Grown in India, China, Africa, and in America in Great Plains area between Rocky Mountains and 98th meridian. Texas, Oklahoma, Kansas, and Nebraska favor crop.

Mature panicles are compact, dense, crowded with spikelets and with the large grains. Varieties of kafir include red, white, pink, and blackhull. Others have pink grains. Spikelets loosely hairy, awnless, with supporting scale about ½ as long as grain that is broad to spherical. Annual. Pink matures in 110 days.

Kafir was brought to Great Plains area of United States about 1875. Commonly drilled into soil. Provides excellent ensilage and a fair quality of forage. Area devoted to growing grain sorghums of United States approximates that devoted to rye. From 4-6 lb. of seeds are needed to acre for grain; 50-70 lb. for fodder.

Grains used commonly for feeding stock, poultry, and to some extent, humans, grains being fed whole or crushed. Breakfast foods, pancakes, and bread of kafir locally common. Stalks properly cured make excellent fodder. Grain 16.8% water, 6.6% protein, 3.8% fat, 70.6% carbohydrate, 2.2% ash.

Durra

Holcus sorghum v. *durra*

Durra includes milo and feterita, according to some authorities. Stems slender to mid-stout. Leaves 8-10. Smaller in all respects than kafir, although feterita may be almost as high. Pith dry and not sweet. Some durras are mature when no more than 2 ft. high. Leaves commonly break off before maturing.

Durra is native of the Nile region in Africa, from which we get the varieties most commonly grown. Yellow milo, Jerusalem corn, and feterita are all kinds of durra. Closely related shallu from India and tropical Africa, and kaoliang from China and Manchuria, have not established themselves in this country.

Panicle of durra is compactly oval, erect or goose-necked (bent over). Grains are flat or flattened, large, unlike those of kafir and are commonly white or reddish-brown and covered by greenish, strongly nerved scale at base. Stems ripen with or before the grain, 72-82 days. Total growing period 102-150 days.

Durra is smaller than kafir, less valuable as forage, and earlier but is better adapted to growing on dry areas, particularly where the growing season is short. Plants are drilled so that they will be about 4-6 in. apart if grown for grain or forage, with 4-6 lb. of seed per acre.

Durra grows slowly until settled warm weather, when it matures quickly. It is harvested by cutting and shocking, and shocked material is threshed. Durra makes good poultry food and, in some areas, fields attract ducks for waste grains left.



Sugar
Cane



Beard Grass



Crab Grass

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Sugar Cane

Saccharum officinarum

Height to 15 ft. Stems solid and heavy as in corn, with leaves springing singly from solid joints. Leaves stiff, to 2 in. broad, 1 or more feet long, smooth on both surfaces, sharp on edges, with prominent midrib and long tapering point. Sheath of leaf overlaps and is hairy at top.

Probably native of southeastern Asia. Important sugar-producing areas now are British India, Java, Cuba, Hawaii, Puerto Rico, as well as in Africa, Australia, and South America. In United States, sugar is produced most abundantly in Florida and Louisiana. It cannot survive killing frosts.

Flower cluster is an open panicle, fluffy, 1-2 ft. long, little spikelets being conspicuous because of their white, downy tufts of hairs. In agricultural practice, reproduction is by cuttings usually from tops of plants. Sometimes underground parts are divided and used to start new plants. Perennial.

Fields are plowed deeply, even to depth of 2 ft. Stable manure best fertilizer if potash and phosphorus are returned from sugar-mill trash. Stem sections 4 tons to an acre, are laid every 2 ft. in rows 4-6 ft. apart and covered with earth and fertilizer. Clean cultivation is necessary. Crop matures in a year.

One of most important food plants grown between 33°N. and S. of equator. Sugar content lost rapidly in first 24 hours, so must be removed near the growing field. Rollers remove 75% of sugar first time. Remainder is removed by further rolling and spraying with hot water. Sugar most efficient energy-producing food available to man.

Bluejoint, Turkeyfoot, Beard Grass

Andropogon furcatus

Height to 6 ft. Rather stout stems arise from underground, short rhizomes, in large tufts and may be branched near summit. Leaf to $\frac{3}{8}$ in. wide, with margins very rough, and surfaces often densely soft and hairy, this being particularly true in lower portions of plant. Name bluejoint refers to stems.

Native plant ranging from Quebec and Maine to Saskatchewan and Montana, south to Florida and Mexico and particularly in Wyoming, Utah, and Arizona. Favors dry soils, prairies, and open woods and grows frequently mixed with other species of grasses.

Flowers borne crowded at tip of erect stems that branch often into 3 parts and resemble a turkeyfoot, thus giving rise to the name. These are usually purplish and each section is to 4 in. long. Stamen-bearing spikelets are slightly longer than those bearing fruit. Perennial.

A native plant that is unquestionably a valuable forage grass in prairie states and in adjacent Mississippi Valley. Not extensively cultivated but has an underground system that is persistent and permits grazing without plant being destroyed. Sometimes recommended in grass mixtures.

This species has won favor as a soil anchor against wind and water erosion.

Crab Grass

Digitaria sanguinalis

Height to 4 ft., arising from sprawling stems that root freely at the joints. Leaf blade 3-6 in. long and $\frac{3}{4}$ - $\frac{1}{2}$ in. wide, rough, more or less hairy particularly in the basal region, dark-green. A number of varieties and closely related species give many modifications.

Common in fields and gardens, lawns, pastures, and waste places throughout the United States at low and medium altitudes, being most common in East and South. Found generally in temperate and tropical parts of world. Native of Europe and cultivated in Germany and Poland.

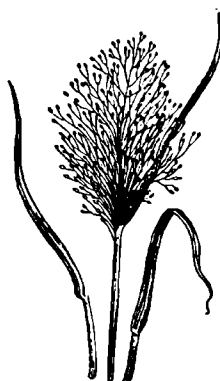
Flowers borne in slender, crowded branches at tip of flowering stalk, often appearing like fingers of the hand and giving the common name finger grass. Flowers from July to October and is propagated by long-lived seeds or by plant parts. Seeds from August to October. Annual.

Appears quickly in fields after usual grass crop has been harvested; this is recognized as valuable in the South since forage is nutritious and is easily produced. In gardens, particularly in moist seasons, plant may become a pest. Fruits appear as impurities in commercial seeds.

If plants are prevented from seeding a few years and clean weeding is kept up, crab grass will disappear from a garden. Forage value of plant should not be overlooked when it is being condemned as a garden weed. Seed are cooked in milk like sago in Europe and eaten by man as a highly nutritious food.



Proso Millet



Tickle Grass
Old Witch



Barnyard Grass

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Proso Millet
Panicum miliaceum

Height to over 4 ft. Stem slender, rather smooth or hairy, usually unanchored, in an open or compact cluster with tips usually bent to one side. Leaves narrow, somewhat hairy, with basal sheaths with weak hairs and awns at upper edge. Unlike perennial grass, *P. barbinode*, this species is annual.

Probably native of East Indies. Now grown rather widely over world in suitable situations. In North America, its popularity in Northwest and more recently in Middle West. Evidence shows that it was cultivated by early dwellers of Europe. It has many red-grass relatives, there being some 10 species in genus.

Flowers borne in rather open clusters somewhat like stiff, erect, corn tassels. Each spikelet bears 1 fertile floret, beneath it 2 empty glumes or scales and a neutral one that bears stamens. Grain to $\frac{1}{16}$ in. across, smooth, white straw-colored, shining. Colors vary in different varieties.

Grown in America, mostly as a forage grain that is highly nutritious. In addition to carbohydrates of plant, grains contain to 10% protein and to 4% fat. Makes an excellent forage for fattening pigs in field, often being offered as a substitute for sorghum and maize in fattening hog diets.

Little or no value as a hay producer. Palatable bread has been prepared from fresh fruits. Leading countries raising this crop are Russia, China, Japan, India, and southern European countries. Known variously as Proso millet, millet, French millet, hog millet, Russian millet, Indian millet, and common millet.

Tickle Grass, Old Witch
Panicum capillare

Height to 2 ft. Stems erect or spreading from base, smooth or densely covered with rather long hairs. Leaves to 10 in. long and nearly 1 in. wide, with densely hairy sheaths and with shorter hairs on both surfaces of leaf blades. Stems break readily at joints.

Common, particularly on sandy soils in fields and waste places from Nova Scotia to British Columbia and south to Florida and Mexico. A native plant often appearing as a tumbleweed when tops break loose and are blown across fields or snow.

Flowering cluster, a large, open, spreading group of thread-like branches often well over 1 ft. across, when mature, branches are stiff and brittle. Grains small, grayish-brown, shining, borne singly in little spikelets that are about 0.1 in. long. Annual.

Plant of doubtful value. In rich soil, it does not stand competition with other plants and gives in quickly to cultivation so it is not a serious pest. Fruits may be of some slight value as food for smaller seed-eating birds of open fields. Found as seed impurity of commercial seeds.

Easily controlled by preventing development of seed, by hand pulling, and by ordinary cultivation practices. The related *P. dichotomiflorum* and *P. virgatum* occasionally serve as food for wild waterfowl.

Barnyard Grass
Echinochloa crus-galli

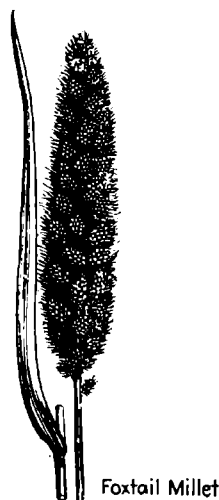
Height to 5 ft. Stems branching profusely from base and ascending, stout, rather succulent. Leaves and sheaths smooth. Related *E. walteri* in Southeast may reach a height of 9 ft. Plants break easily, leaving reproductive portions in the ground.

E. crus-galli found from the mouth of the Gulf of St. Lawrence to southern British Columbia, and south to Mexico common on wastelands and along the borders of fresh-water areas. A variety *mitis* abounds along marshes in Northern states and others are recognized. *E. walteri* may be found in brackish areas.

Usually, flower cluster appears to be bristly because of the awns, but awns are lacking in some varieties. Flower cluster may appear purple or pale green, erect or drooping. Fruits appear to be hard and firm, more pointed at one end than the other, and are able to retain their vitality for a long period.

Under name of wild millet is recognized as one of best duck-food plants of shallow marshes and moist soils. Attracts songbirds, upland game birds, and some forms even attract muskrats. Variety *frumentacea*, known as "billion-dollar grass" or "Japanese millet," is occasionally cultivated as bhasi.

Seeds common as impurities in commercial seeds. Plants are unusually valuable in wildlife management because they produce abundant seeds, are hardy, grow with little care, and are generally cheap. Planted in drills at 1-2 pecks an acre. Grass is 76% water, 0.7% fat, 1.5% protein, 12% fiber and ash.



Foxtail Millet



Green Foxtail



Yellow Foxtail

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Foxtail Millet
Setaria italica

Height to 5 ft. Stems smooth, conspicuously jointed, somewhat branched at top. Leaves many, broad, flat, long, pointed to over 1 ft. long, to 1 in. wide, rough, with large sheathed bases. Root system relatively small.

World-wide in cultivation. Foxtail millet or German millet was said to be 1 of 5 species of plants that Chinese Emperor sowed each spring in a public ceremony established 2,700 B.C. Other common millets are Hungarian and Japanese millets.

Flowering panicle compact, interrupted or lobed, heavy, usually purple, yellow, or green, to 1 ft. long, to 2 in. wide. Fruits about $\frac{1}{2}$ in. long, smooth, yellow, brown, red, or nearly black, egg-shaped but somewhat flattened on one side. Annual. Matures 6-10 weeks after planting.

In United States, millets are grown mostly for forage or in a crop rotation where a quick, green vegetation is needed. Varieties include black-seeded Hungarian grass; red- or orange-fruited Siberian or Turkestan millet; and yellow-fruited, German or golden wonder millet.

In India, Japan, Korea, and China, millet is raised extensively for human consumption, but in America its place is that of a quick crop to replace an early crop failure, or for forage, or for grains for poultry. Excellent for planting at field margins and, in suitable waste places, as food for certain upland game birds.

Green Foxtail
Setaria viridis

Height to 3 ft. Erect, usually unbranched, springing from tufts close to the ground. Leaves to 1 ft. long and to 0.4 in. wide, roughened on the margins, with smooth sheaths, dark-green. Vigorous, quick-growing plant with erect stems curving near the ground.

Native of Europe but widely established throughout world in almost any kind of soil, but particularly in poorly cultivated lands and waste places. In America, found commonly everywhere but in far north. Found mostly in late summer but tops remain erect through the winter.

Flower clusters spike-like, but made of many spikelets, to 4 in. long, nearly 1 in. through. Bristles 2-6 at base of each spikelet, barbed upward. Grain about $\frac{1}{2}$ in. long, doubly convex, commonly brownish or greenish, smaller than yellow foxtail. Blooms July to September. Annual.

Fruits commonly found in clover seed. Plant has some food value, being 14% water, 7% ash, 7% protein, 3% fat, 19% fiber, 50% nitrogen-free extract, this analysis being of freshly dried hay. Sometimes a bad pest in lawns, where it is found more commonly than is yellow foxtail.

Extermination is by hoe-cutting or hand-grubbing of plants in lawn or garden. Sometimes fields are burned over to destroy foxtail and if the pest is to be controlled, seed production should be prevented as much as possible.

Yellow Foxtail, Pigeon Grass
Setaria lutescens

Height to 4 ft., and arising from branching bases. Stalks commonly compressed at base, sprawl over ground before rising. Leaves to 6 or more inches long and to $\frac{1}{2}$ in. wide, flat, smooth, and usually hanging twisted, with loose sheaths, lower of which may be red. Roots clustered and fibrous.

Found in cultivated lands all over world, being particularly common in cultivated areas and waste places where soil is loose. Naturalized from Europe and probably introduced with commercial seeds since it matures its fruits at same time many valuable species do.

Flowering clusters spike-like, but composed of many spikelets, these being closely crowded, 1-sided and subtended by 6-10 upwardly barbed bristles that are brownish-yellow and much longer than the spikelets. Grains about 1.8 in. long, yellow, brown, or pale green. Annual.

Cattle will eat young grass but old plants are worthless as fodder. Green plant is 81% water, 10% fiber and ash, 2% protein, 7% nitrogen-free material. Once seeds are established in soil, their vitality is great and plants may appear regularly.

Game birds and birds that remain north in winter find fruits above snow a most acceptable food and will clean plants when they are to be found. For this reason, plant has a place in wildlife management. To control pigeon grass in cultivated lands, cultivate late, graze with sheep, and prevent seeding.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Sand bur
Amaranthus tribuloides

Stems to 2 ft. long, branching and rising to tips to 10 in. or more. Leaves to 5 in. long, with loose, flattened sheaths, with hairy margins, with fringed throat and smooth, flat, sometimes curled blades. Shorter stems sometimes erect, or sprawling.

Common from Maine and Ontario to Florida and southern California as well as in other parts of world. It is not found in all areas in this range, but in South and Middle West it is particularly troublesome. As name implies, it is common on sandy soil, shores, and dry waste places although it sometimes is found in lawns.

Flowers borne in 8-20 clusters, of 2-6 flowers that are almost enclosed by prickly bracts that make burs about 1/4 in. in diameter, thickly set with strong prickles stiff enough to penetrate shoe leather, barbed backward, and most difficult to remove. Spines break off freely. Annual.

One of pests of prairie states for those who like to roam in waste places without protection of strong leather. Burs often get into wool of sheep and other animals and are almost impossible to remove. They may make their way to the skin and cause serious irritation.

Little if any good use for plant. Too weak to take care of itself. However, roots are shallow and do not stand exposure well, so if there is shallow cultivation of an infested spot the plant may soon disappear. Animals carry seeds from place to place in burs. Infested areas are commonly burned over.

Rice
Oryza sativa

Height to 4 ft. Erect, growing from stools. Fruiting stem angled, smooth, almost entirely enclosed by sheaths of leaves that are smooth and conspicuously nerved. Leaf blades long and about 1/2 in. wide, more or less roughened. One seed will produce several of the erect stems. Over 2,400 varieties recognized. Wet- and dry-land forms.

Has been under cultivation in China at least 4,000 years. As it grows wild in southern China, it is probably native of the area. Introduced into western Asia, then Europe. Brought to America for growing in 1694 near Charleston, S.C. Average summer temperature above 77°F.

Flowers in compact panicles. Hull usually yellowish-brown. Inner grain white and hard. In hull, rice is known as "paddy." Without hull, called "cleaned rice." Carolina gold rice, commonly grown in Carolinas, has golden-yellow hulls; Japan and Honduras rice grown in Texas and Louisiana have yellow-brown hulls.

Polished rice has about 12.3% water, 79% carbohydrate, 8% protein, 0.3% fat, 0.4% ash, and 102 calories per 100 grams. Unpolished rice has a higher food value. Seed sown, 1-3 bushels an acre in drills, mid-April to mid-May; water is not applied until rice is 8 in. high. Water to 3-6 inches is then flooded in until crop is mature.

United States imports more rice than it raises but is not a major rice-consuming country. Rice bran is fed to cattle. Rice straw is made into rice boards and straw hats, but rice paper comes from mulberry or bamboo. Polished rice lacks vitamins necessary for preventing the disease beri-beri, which in some stages may be cured by eating unpolished grain.

Wild Rice
Zizania aquatica

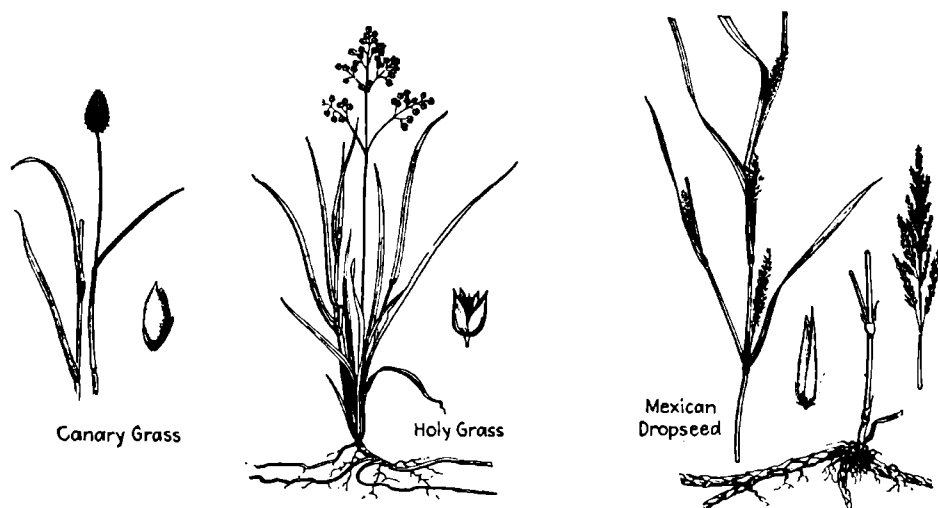
Height to 9 ft. Leaves to 2 in. wide, to 40 in. long, flat, green, curving backward from base that sheaths stem. Roots relatively short, easily pulled. Two varieties recognized, variety *interior*, of the Middle West, being about 2 times height of the eastern *angustifolium*.

Found from mouth of St. Lawrence to central Manitoba, south to Kansas and Virginia and around coast to Louisiana. Common in shallow water, on muddy shores, or in water to 3 ft. deep and in salinity up to 3.5% that of normal sea water. Water salty enough to be tasted is not suitable for wild rice.

Flowers borne in loose open clusters, at top of plant, uppermost bearing pollen and lower ones bearing valuable fruits. Fruits enclosed in thin, papery, minutely roughened scales. Flowering takes place in July and August in northern part of range. Annual.

One of most commonly cultivated of wild foods for game. Usually is planted by broadcasting fruits in fall or in early spring. Ducks that have fed on wild rice and wild celery are supposed to be superior food for man. Whole grain 9.5% water, 12.9% protein, 1% fat, 75.2% carbohydrate, 1.4% ash.

One of more important of foods for most plant-eating wildlife. Fruits and plant parts eaten, but fruits are most important. They attract waterfowl of all sorts, songbirds, upland game birds, muskrats, deer, and moose over a wide area for a considerable season.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Canary Grass
Phalaris canariensis

Height to 3 ft. Erect fruiting stems smooth, usually unbranched. Leaves with sheaths, loose, rough, shorter than space between joints; with blades to 1 ft. long and nearly $\frac{1}{2}$ in. wide, rough and flat. Root system not elaborate.

Found from Nova Scotia to Alaska, south to Virginia, Kansas, Wyoming, and California, sometimes farther south; introduced into Mediterranean region. Found mostly in gardens, on roadsides, and in waste places. Grown to some extent and has established itself widely through being an impurity of some commercial seeds.

Flowering head a dense spike about 1 in. long and $\frac{1}{2}$ in. thick, composed of 1-flowered spikelets that crowd each other, overlapping closely and showing keeled scales that are whitish with green veins. Flowering time from July to August. Fruits produced in August and September. Annual.

Probably known to more people because of shining fruits that are fed to canaries as "canary seed." Conspicuous grass but can hardly be considered a common weed except in limited areas. However, it sometimes gets established as a weed and may need control measures to keep it from spreading.

If seed production is prevented, plant will disappear quickly in most areas where it is found. Vegetative part is worthless as hay or as forage for livestock. Flour from seed is used in making weaver's glue for sizing cotton.

Holy Grass
Hierochloa odorata

Height to 2 ft., erect stems arising from a creeping rootstock that winds, divides, and forms a mat. Erect stems unbranched, slender, and smooth. Leaves of flowering stems short, smooth or slightly roughened. Late leaves flat, rough, deep green, and longer than earlier leaves.

Ranges from Newfoundland to Alaska, south to Pennsylvania, Colorado, and Oregon and also a native of Europe and Asia. Commonest in northern part of range along coast and Great Lakes area usually in moist meadows and prairies, though it sometimes becomes a pest in managed pastures that are wet.

Flowers borne in open panicles, to 5 in. long, in May and July. Individual spikelets about $\frac{3}{8}$ in. long, brownish, enclosed by 2 scale-like structures. Those bearing stamens are awnless; those bearing grain, hairy at tip. Much reproduction is by spreading rhizomes. Perennial.

After fruits have matured by first of June, a new growth appears that is more vigorous than early vegetation. This growth provides a reserve of food that is stored underground and makes possible early flowering and fruiting the following year. Vanilla-like fragrance is best at flowering time.

Useless as hay or forage. Dried leaves and tops are made into "sweet grass" baskets, put into pillows and dresser drawers because of their fragrance and are strewn at church entrances in northern Europe to give off fragrance, whence the name holy grass. Eradication by spring plowing or by burning ripened grass.

Mexican Dropseed
Muhlenbergia mexicana

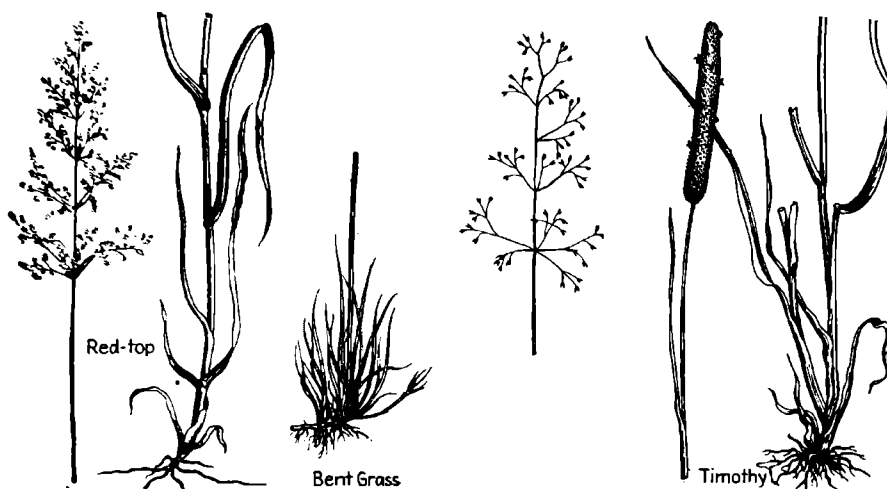
Height to 3 ft. Stems smooth, commonly branching at the base and rising to erect position from the ground, with roots at joints that touch the ground. Leaves to 6 in. long and under $\frac{1}{4}$ in. wide, smaller on branches and more crowded there. Roots clustered and relatively shallow.

Found in moist fields and meadows, in ditches, and on banks of waterways from Newfoundland to British Columbia, south to Florida and Mexico covering thus whole of United States. Also found native in Europe and Asia. Seems to be more common in eastern parts of United States than in western.

Flowers borne in slender, loose, weak clusters, whole panicle sometimes up to 6 in. long and hanging almost as though it were wet. Spikelets small, about $\frac{1}{2}$ in. long, and about equal in length to brown seeds they produce. Embryo end of seed is darkest. Perennial.

When young, leaves are eaten readily by livestock but old plants are so wiry they are rejected. Fresh hay of a 2-ft. plant is 73% water, 10% nitrogen-free content, 10% ash and fiber, 5% protein, 1% fat. Water content may vary from 50-84%, the latter being in the young plants.

Dropseed may provide food and shelter for some kinds of game and at times may be useful forage for cattle in places where shade and amount of water are too great for other plants to survive, but usually better plants can be found. It is a good soil anchor and pioneers in this along streams. Cultivation destroys it.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Red-top, Bent Grass
Agrostis alba

Height to 4½ ft. In creeping bent, *A. palustris*, there are long, rooting runners at base and erect stems sag at base. In black bent, *A. nigra*, runners are short, stout, and leafy; in typical redtop, *A. alba*, rootstocks are horizontal and fruiting stalks are erect. Leaves to 0.4 in. wide.

Native of Europe, but generally naturalized in northern parts of United States and in Canada. It favors meadows and open fields where pasturing is common. Different varieties are sufficient to provide grasses suitable for being grazed or for being cut as hay.

Lowering panicle to 1 ft. long, openly branching, of slender parts, arising in whorls from a central stem, greenish, purplish, brown, or red, and lightly rough. Scales outside fruits nearly equal in length, the shorter being over half as long as the other. Spikelets 1-flowered. Perennial.

Seeding, sown at rate of 12–15 lb. to the acre. Blooms about 6 weeks after Kentucky bluegrass. Grain is about ⅝ in. long and is enclosed in scales about half again as long. "Seeds" weigh 12 lb. a bushel, but cleaned seed may weigh 36 lb. to the bushel.

This pasture grass is less valuable than timothy or bluegrass but it forms a sod more quickly than bluegrass and lives on soils too heavy, wet, or acid for many other grasses to survive. Some think redtop hay as second in value to timothy. Its palatability is less, though its nutritive value is about equal.

Rhode Island Bent Grass
Agrostis canina

Height to 2 ft. Usually seen cut so short that 2-ft. height seems untrue. No true rhizomes, fruiting stems rising directly. Erect stems and leaves fine, smooth, weak, with leaf margins often incurled. Lower leaves almost hair-like and others very narrow.

Commonly found on putting greens of golf courses and on lawns. Gets common name velvet bent from the smooth close sward it may make. Native of America from Newfoundland to Quebec and south to Delaware and Michigan but has been widely introduced throughout world where golf is played.

Flowers borne in loose, open panicle, to 4 in. long. Scales enclosing the single grain are to 0.1 in. long. Outermost scales are to ¼ again as long as inner and the customary inner scales found in closely related forms are minute or lacking.

Useless as a source of hay but seed has a high market value because of its special use in developing golf courses. Some related bent grasses may produce vegetation and fruits that have been found in the stomachs of ducks, but this role cannot be important.

Of the bent grasses, the following have special uses: colonial bent, *A. tenuis*, on pastures and lawns; creeping bent, *A. palustris*, on golf greens; velvet bent, *A. canina*, on putting greens; redtop, *A. alba* on meadows, pastures, and lawns. Some are suited for landing fields at airports.

Timothy, Herd's Grass
Phleum pratense

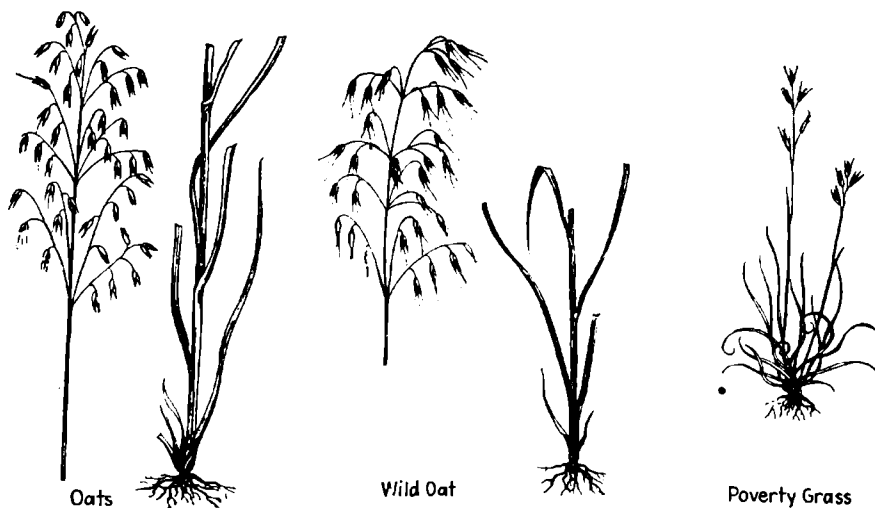
Height to 6 ft. Fruiting stems unbranched, erect, smooth, arising from a thickened bulb-like base. Leaves arising from crown or from fruiting stems, flat, about 1 ft. long and ½ in. wide, rough; with long, smooth, streaked sheaths. Leaves of erect stems more numerous than others.

Found from Europe through North America where pastures and hayfields are managed, but in United States most important in states of Northwest and Middle West. Does best on clay loams where there is good moisture and better in moist climates than in dry ones. Does not do so well on acid soils. In America since 1700.

Fruiting head a slender spike of closely crowded spikelets, the whole being to 6 in. long and to ⅝ in. through. Spikelets single-flowered; grayish-silver fruit is about ½ in. long and is usually enclosed in a loose, papery set of scales.

Probably best of all hay-crop species. Seed weighs 42–50 lb. to the bushel, legal weight usually being 45 lb. Seed sown at 8–15 lb. to acre, or with clover, at 7–10 lb. Without nurse crop, seeding may be done in July or August. Crop usually cut in July, cures quickly and cleanly.

Hay usually has 6% protein, 45% carbohydrates, 2.5% fats, and 29% crude fiber of which only about ½ is considered digestible. Timothy is a bit lower in protein than other grasses but is otherwise equal. When harvested for seed, yields from 2–3 bushels to the acre.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Oat
Avena sativa

Height to 5 ft. A single fruit produces from 3-7 erect, jointed, hollow, fruiting stems from a base of fibrous roots. Leaves numerous, 6-12 in. long and about 1½ in. wide, blue-green, rough, flat, with sheaths that are loose and extend practically from one joint to next.

Probably native of central and western Asia. Although early Greeks and Romans used oats for feeding domestic animals, little evidence that they were used as long as most other cereals. Early American colonists brought oats. A red-rustproof oat of South was developed from African *A. sterilis*. Grown north to 69° in Alaska.

Fruiting head an open panicle, to 1 ft. long, bearing from 40-75 spikelets, each spikelet usually consisting of 2 or more flowers, of which 2 bear fruits. In some varieties, only 1 fruit is borne in a spikelet; in others, 3 are produced. Flowers open for only a few hours, pollination taking place before flowers open.

In most oats, grain weighs 60-75% of total. Early oats, ripen in 90-100 days; late, in 115-130 days. In late April, oats are drilled or broadcast, 2-3 bushels an acre, this being sometimes harrowed in 2-3 times. Yields average around 30 bushels an acre but may reach 200 in Northwest. Hessian fly and a sawfly are worst insect pests.

As food for man, are fair for protein, excellent for minerals and for carbohydrate, and fair for calcium and phosphorus, the bone and nerve builders. Fair for vitamin A and good for vitamin B. About 70% of American-raised oats are used on home farm. Rusts and smuts are serious fungus pests.

Wild Oat
Avena sativa

Height to 5 ft. Erect, growing in tufts from a common cluster of fibrous roots. Smooth. Leaves green, about ½ in. wide and to 1 ft. long. In general, the plant vegetatively closely resembles the cultivated oat.

Common throughout United States but most troublesome in grain-growing areas of Canada and from Minnesota to Oregon and California. Grows in almost any kind of soil. Commonly found in fields planted to cereals and other grasses and to flax. Matures earlier than some of these and thus seeds itself.

Flowering panicles loose and open, much like those of cultivated oat. Flowerlets become much more easily separated from heads in wild oat; stiff twisted awns are nearly twice as long as spikelets that bear them. A grain will germinate and develop a plant when buried 5 in. deep.

Wild oats occupy land used better by cultivated species. Twisted awns cause serious irritation in noses, mouths, and digestive tracts of animals that eat them; seeds can survive going through animal's digestive system. Twisted awns cling to sheep's wool and grain sacks.

Wild oats can be controlled by sowing only clean seed, by following an infested crop with corn or with a clover-timothy meadow. When wild oats appear in hay, every effort should be made to clean it out, for protection of the animals that eat the hay. Wild-oat hay cut before fruits mature is nutritious for cattle.

Poverty Grass
Danthonia spicata

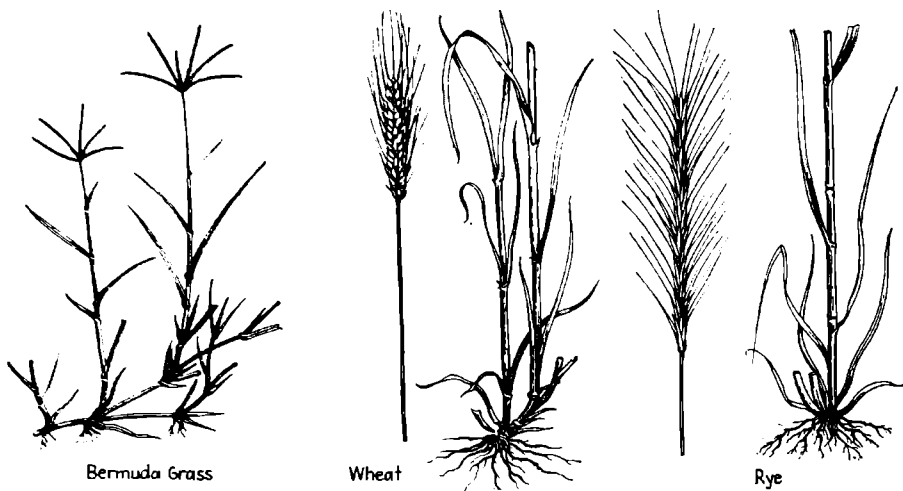
Height to 2½ ft. but normally much lower. Flowering stems round, with leaves that are smooth or sparingly haired. Leaves springing from base are usually twisted and curled at slender tips, forming a cottony cushion close to the ground. Leaves gray-green about 4-5 in. long.

Found through eastern United States and Canada, west to Dakotas and south to Gulf of Mexico, being found often as a clean stand in "worn-out" soils whether sandy, rocky or clayey. Presence of plant may be used as an index of soil exhaustion, since it does not do well on rich soils.

Flowering stalks somewhat like oats but few-flowered, with branches short, with spikelets about ½ in. long, and with twisted awns longer than scales that support them. Flowering panicle about 2 in. long. Seeds usually ripen and fall before hay grasses are ready for cutting.

Interesting to outdoor persons in part because of behavior of leaves in varying degrees of humidity. When mature and dry grass may be collected and piled either loose or in a tick to make an excellent emergency mattress in areas where stones are exceptionally hard for those who sleep out.

Best control of this weed, if this is necessary, is to enrich soil so that it cannot survive competition with plants that may then be supported by it. This implies that soil must also be in condition to hold moisture for other plants as well. One of few native forage grasses.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Bermuda Grass
Cynodon dactylon

Height to 1 ft. Flowering stems erect or sprawling, slightly flattened, much-branched, stiff and wiry when mature. Leaves smooth, flat, light green, stiff, numerous, to 4 in. long, with smooth sheaths crowned with a ring of white hairs. Sheaths overlap and are crowded at base.

Introduced from Europe and established in warmer parts of United States from Maryland west to Pacific Coast and south. It winterkills as far north as Virginia but can be grown during usual season. If roots are exposed to freezing, plant cannot ordinarily survive.

Flowering stalks end frequently in a branched, finger-like arrangement much like that of crab grass. Spikes 5, each to 2 in. long. Spikelets to .1 in. long, closely pressed to axis of spike. Perennial in suitable climates. Rarely reproduces by seeds but mostly by rooting runners.

Refers warm sandy areas, surviving droughts that would kill most other grasses. Because of this, used in south on exposed lawns and golf courses where the heat may be severe. Because of its creeping habit, it may become a pest in fields requiring cultivation. Sometimes serious as a pest to cotton. Hard to destroy.

Best methods of eradication call for use of a smother crop which for a time will cut it off from all light. Millet, cowpeas or sorghum planted close are often used since they can compete successfully and will also produce a useful crop.

Wheat
Triticum vulgare

Height to 4 ft. Flowering stems erect, unbranched, hollow except at joints, to $\frac{3}{8}$ in. in diameter. Leaves to 15 in. long by $\frac{1}{2}$ in. wide, taper-pointed, with a long loose sheath that is finely hairy or smooth. Roots usually near surface, but in favorable soils may penetrate to 7 ft.; grow in whorls.

Cultivated since first records of history and known to have been grown in China at least in 3000 B.C. Mentioned in first book of the Bible, and was grown in western Asia, Europe, and northern Africa long before it was introduced into America. It grows to within 200 miles of the Arctic Circle; on mountains at equator.

Flowering spikes compact, composed of numerous spikelets, with 2 or more flowers in each spikelet. Spikes to 4 in. long, cylindrical except in some varieties. Fruit an oblong grain about $\frac{1}{4}$ in. long that frees itself readily from the enclosing scales and is usually fuzzy at the top. Self-fertilization is the rule. Annual.

About 60% of American wheat is winter wheat, most of which is of turkey red variety. $1\frac{1}{2}$ –2 bushels are drilled per acre to depth of 1–2 in. to mature in about 100 days of growing weather. Fields are harrowed in drilled direction. Worst enemies are rusts and smuts of wheat, chinch bugs, and Hessian flies.

The "staff of life" as food for man is fair for protein, calcium, and phosphorus, and vitamin A; good for vitamin B; and excellent for minerals and carbohydrates. An average yield per acre is about 14 bushels, but yields to 30 bushels have been reached. Very important crop in southern Canada.

Rye
Secale cereale

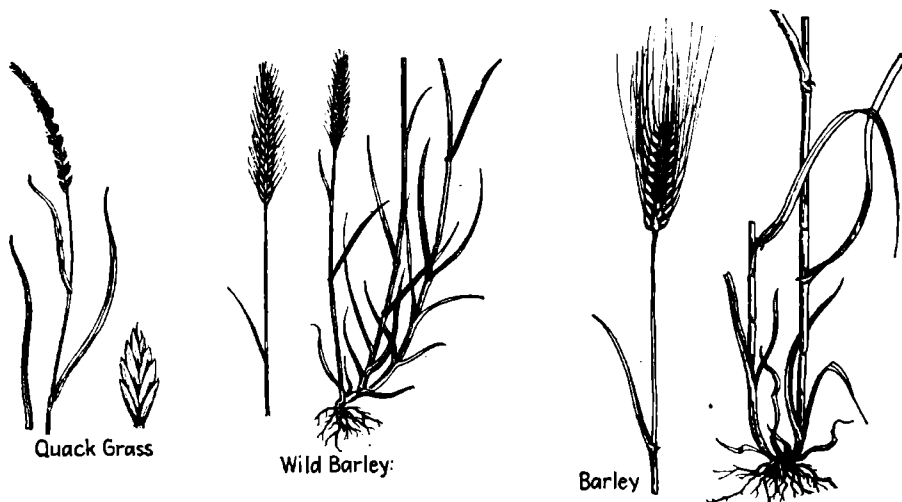
Height to 6 ft. Flowering stems erect, unbranched, smooth, except near top, slender. Leaves to $\frac{1}{2}$ in. wide, long-pointed, soft, nearly smooth, blue-green, many curved. Roots fibrous, well-matted. Tallness of rye in fact and in appearance is always characteristic.

Comparatively recent among cultivated plants. Not known to early Greeks and Romans. Probably originated in western Asia and southeastern Europe. It will generally grow on poorer soils than those required by other cereals. It does best on loam soils. Pennsylvania, Wisconsin, and Michigan are rye states.

Flowers borne in terminal spike to 6 in. long, well-awned, narrow, closely flowered, with spikelets with 2 seed-producing flowerlets and possibly one that is not. Flowers more likely to cross-pollinate than do most cereals. Fruits about 1.3 in. long, light brown, narrow, pointed, with narrow groove on face, smooth.

Planted in drills or broadcast at 5–6 pecks per acre, planted to a depth of 2–3 in., seldom cultivated. Planted in fall or spring but matures in about 100 growing days of spring. If planted for fall pasture, seeds are sown in August in North or in September in South; if for grain, September in North, October in South.

Average production per acre in good states is 20 bushels, although 17 is considered excellent in others. Used to make "black bread" in poorer countries in northern Europe, as grain to feed hogs and horses in America, and in making alcohol for whisky. About $\frac{3}{4}$ goes to animal food and $\frac{1}{8}$ to flour and alcohol.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Quack Grass
Agropyron repens

Height to 3 ft. Flowering stems erect, or curving from base, arising from long, creeping, yellowish rootstocks that persist for a long time buried in soil. Leaves with blades, relatively thin, flat, mostly sparsely covered with short hairs on upper surface, to $\frac{1}{2}$ in. wide. Spikelets with side to axis.

Found in waste places from Newfoundland to Skagway in Alaska and south to North Carolina, Arkansas, New Mexico, and California. Introduced into Eurasia. Common in waste places, among cultivated crops, particularly grasses, and most common in northern part of range within United States.

Flowering cluster spike-like, to 6 in. long, with main axis roughened on angles, spikelets mostly 4-6-flowered, to 0.6 in. long. Flowers appear in June; mature fruits in July. Cutting underground parts of plant does little damage but rather increases number of plants since each section establishes itself.

Considered by farmers worst of grass weeds because it offers too keen competition with other plants and once established is difficult to eliminate. Often badly infected with a stem rust and with ergot. Quack grass can make a good hay, yielding 2 crops a year, and cattle relish the new growth as pasturage.

Best control is by putting on such a heavy mulch that underground portions are starved out. Late fall plowing followed by persistent harrowing in fall and spring may help, followed by a crop that will be hoed, followed by burning trash after harvest. Quack grass is a superior soil anchor against erosion of waste hillsides.

Wild Barley, Foxtail Barley
Hordeum jubatum

Height to 30 in. Flowering stalks unbranched, erect or inclined, slender, tufted. Leaf blades to $1\frac{1}{2}$ in. wide, rough, somewhat grayish-green, to 5 in. long, flat. Sheaths shorter than space between joints. Some stems may lie close to ground for a considerable distance.

Found in waste places, roadsides, fields, meadows, and open pastures from Newfoundland and Labrador to Alaska and south through Maryland, Illinois, Missouri, Texas, California, and Mexico. Has been introduced through the Eastern states but is a native of America.

Flowering spikes nodding, to 5 in. long, with spreading awns making them about as thick as long. Spikelets in 3's, on opposite sides of main, flattened, jointed axis. Each spikelet that bears a seed has 7 long barbed awns; those not producing fruits have 3 such awns. Perennial, biennial, or annual.

Single clump may produce to 2,000 awned "seeds" that may be borne great distances in wool of sheep, by wind, or by water in irrigation ditches. Awns become brittle when ripe, penetrate lining of mouths of cattle that eat them and cause "lumpy jaw," get into eyes and cause blindness, or pierce alimentary canal and cause death.

Even though grass may have some value as forage in young stages, dangers from mature plants are too great to encourage plant except where more desirable kinds will not grow. Extermination is by repeated early mowing, cultivation, or burning over of infested areas.

Barley
Hordeum vulgare

Height to 3 ft. Flowering stems arising in clumps up to 15-20, unbranched, smooth or roughened under the flowers. Leaves short, long-tapering pointed, to $\frac{3}{4}$ in. broad; sheaths, loose and smooth. Leaves appear broader than in other grains and more conspicuously gray-green.

One of oldest cultivated plants. Carvings on Egyptian tombs show it. Mentioned in earlier books of the Bible. Probably cultivated as early as wheat and earlier than oats or rye; probably originated in Asia Minor from a form now wild there, *H. spontaneum*. Was brought to earliest Massachusetts and Virginia colonies.

Head of flowers much like wheat, to 4 in. long, densely flowered, erect, or nodding, with many stout, erect, very long beards that extend far beyond end of spike, some being 6 in. long. Fruit elliptic, about $\frac{1}{4}$ in. long, short-pointed, smooth, furrowed length of face, usually enclosed in hull.

Types include 2-rowed, 4-rowed, and 6-rowed, bearded, hooded, beardless, hulled, hull-less; winter and spring forms. Winter barley less hardy than winter wheat but more so than winter oats. Winter varieties are mostly 6-rowed. Almost any barley can survive winter in South.

Planted 6-10 pecks an acre in drills in late April; matures in 90-100 days after being harrowed 2-3 times in direction of drill. About $\frac{1}{2}$ of crop used in making malt by partly germinating seed. In Mississippi Valley, important in hog foods. As human food, fair for protein, phosphorus, and calcium, excellent for mineral.



Wild Rye



Perennial Rye Grass



Fescue Grass

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Wild Rye

Elymus canadensis

Height to 4.5 ft. Erect, tufted, green, or gray-green. Flowering stems slender, unbranched, drooping at tip. Leaves flat, roughened above, to $\frac{3}{8}$ in. wide, with sheath smooth, or rarely finely hairy. Roots fibrous and rather widely spreading.

Found in moist, open, or shaded ground, or in open woods, on river banks, or low ground from Quebec to southern Alaska, south to North Carolina, Missouri, Texas, Arizona, and northern California, with varieties extending the range considerably.

Flowering spike nodding, to 10 in. long, with spikelets commonly in 3's and 4's, slightly spreading, and conspicuous with loosely spreading awns. Scales about fruits are narrow, and mostly with 2-4 nerves, with awns about as long or longer than scale itself. Perennial.

A relatively large group of these rye grasses are to be found growing wild in many places in United States. Serve to great need but add beauty often by their nodding tops that persist through winter months.

To botanists, interesting because of closely related species with distinct characteristics, which include erect Virginia wild rye *E. virginicus*; the slender, finer, *E. striatus*, and others. May yield some small amount of food and protection to wildlife.

Perennial Rye Grass

Lolium perenne

Height to 30 in. Flowering stems erect, or sagging at base, unbranched, smooth. Leaves flat, smooth, 2-5 in. long, to 1.6 in. wide, dark-green, with sheaths definitely shorter than space between joints. Best field characteristic is glossy nature of whole plant.

Found in meadows and wastelands, from Newfoundland to Alaska, south to Virginia and California and even farther south. It was introduced from Europe and is cultivated sometimes in meadows, pastures, and lawns. Sometimes called English rye grass.

Flowering spike 3-8 in. long, with spikelets set with their edges to the main axis and their tips well away from axis. Spikelets have lowermost scale slightly shorter than spikelet, being in this respect unlike related poison dandel, in which this scale is longer than spikelet.

Requires moist ground and a cool, moist climate. Its seeds closely resemble those of meadow fescue and are sometimes used as an adulterant of that more valuable grass. It does best in northern parts of British Isles. If it is allowed to go to seed, it is unusually exhaustive to soil.

Planted sometimes in grass mixtures where a field varies greatly, with thought that it may grow where others of mixture will not. It can be controlled by early cutting. Though it is a perennial, it is not ordinarily long-lived and does not stand competition well.

Fescue Grass

Festuca elatior

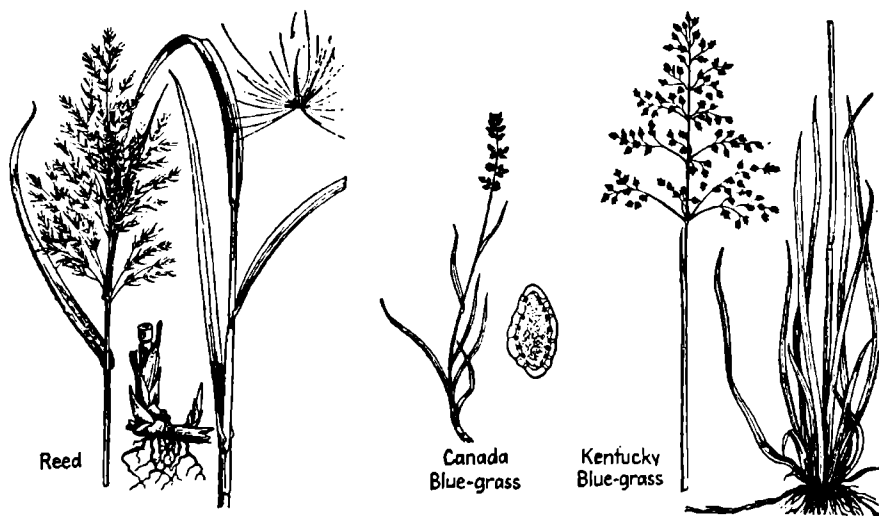
Height to 4 ft. Loosely tufted, and often from short creeping rootstocks. Flowering stalks erect, smooth, with nodding flower cluster at the top. Leaves with flat blades, to $\frac{3}{8}$ in. wide, roughened above. Sometimes called English bluegrass.

Native of Europe. Widely established in America throughout United States and Canada but does best in the cooler areas. It is cultivated for meadows and pastures. Meadow fescue *F. pratensis* is commonly grown in Kansas and it, with fescue grass *F. elatior* is grown commonly in Washington and Idaho.

Flowering panicle erect or nodding, usually much branched but becoming contracted after flowering, to 8 in. long. Spikelets to $\frac{3}{4}$ in. long, with 6-8 flowers, rarely with short awns. Empty scale is about $\frac{3}{4}$ in. long, smooth, faintly streaked.

In Europe and particularly in England, fescue is considered one of more important grasses. In America, it is most commonly grown in mixtures. In the timothy-growing region in America, fescue can never compete with that grass.

Seeds or fruits are occasionally found mixed with commercial brome grass or rye grass but they are considered inferior to these by most farmers. To seedsmen, standard fescue should be 95% pure fescue, and 85% of the seeds must germinate.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Reed
Phragmites communis

Height to 12 ft. Growing from stout, horizontal rootstocks that interlock firmly and crowd out other species. Leaves flat, to 2 in. wide, to 2 ft. long, smooth and with overlapping sheathes at the base. A single rootstock may extend over 30 ft.

Found in wet places, at edges of marshes or ditches, across continent, and in Europe and Asia, but most commonly in or near brackish water. Minor differences between reeds of Europe and America not to be considered here. Reeds grow in same kinds of places as wild rice.

Reproduction commonly by means of spreading rootstocks. In fact, seeds are only rarely perfected. Whole flowering part of plant is conspicuous because of long, silky hairs on flowering spikelets that are individually about $\frac{1}{2}$ in. long but are crowded into a large mass.

In part, because plant matures few seeds, this is not considered a desirable species in wildlife management. While wild rice pulls easily because of weak root system, it is almost impossible to pull up reeds. This makes the reed useful in flood control where the rice would be useless.

Reeds would be planted only for shelter by a wildlife manager. Instead, they are often destroyed by crushers that cut up the undergrown system, since mowing does not seem to destroy them. A mass of reeds has a unique beauty when in bloom.

Canada Bluegrass
Poa annua

Height to $1\frac{1}{2}$ ft. Flowering stems sprawl on ground before becoming erect, strongly flattened, usually not crowded. Leaves and whole plant conspicuously blue-green. Leaf blades short, not over $\frac{1}{4}$ in. wide. Perennial. With extensive, creeping rootstocks.

Found from Newfoundland to Alaska, south to Georgia, Alabama, New Mexico, and California and introduced into Europe. Grows fairly well on poor soil where more valuable species cannot survive. Found mostly in open fields, along roadsides, in waste places, in open woods, and meadows.

Flowering panicle to 3 in. long, usually onesided, much more sparse than that of Kentucky bluegrass. Usually short branches are in pairs bearing spikelets to the base. Spikelets crowded, to $\frac{1}{2}$ in. long, with 3-6 flowers. Seeds of Canadian smaller and lighter than those of Kentucky bluegrass. Perennial.

Standard commercial Canada bluegrass seed must be 90% pure and must germinate 45%. Of considerable value as forage species on farms with poor soil of marginal and submarginal type, and particularly on heavy clayey soils unsuitable for Kentucky bluegrass. Finds most favor in eastern Canada, New York, and New England.

Without grasses of this type, many farms would not be profitable. Helps build soils and make them eventually suitable for more valuable grass species. Excellent as a soil anchor, for flood and soil control. While volume of forage produced is not great, nutritive value is relatively high.

Kentucky Blue-grass
Poa pratensis

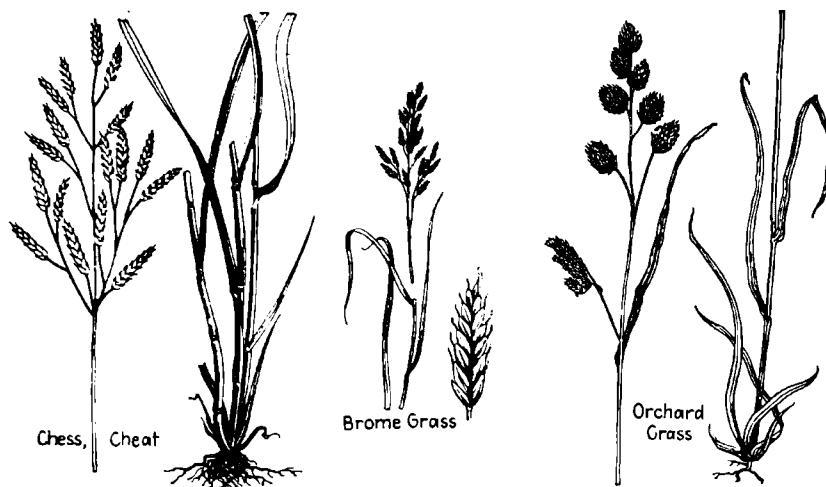
Height to 3 ft. Flowering stems tufted, erect, slightly compressed. Leaves with boat-shaped tips, those on flowering stems rarely over 6 in. long and $\frac{1}{4}$ in. broad, but the basal leaves are larger. Blades soft, flat, or folded. Roots rather shallow, but underground spread to form a dense sod.

Either a native of region from Pennsylvania west to the Mississippi or introduced from Europe at an early date. Essentially a grass of open country but lives in open woods, as well as in meadows and humid pastures. Grows at altitudes higher than those acceptable to most cultivated grasses.

Flowering panicle pyramid-shaped, open, lower branches coming off usually in a whorl of 5, with usually a long central one and shortest pair on outside. Spikelets 3-5-flowered, with a length of to $\frac{1}{4}$ in. Grain is enclosed in 2 scales which are from $\frac{1}{16}$ - $\frac{1}{8}$ inch long, being longer than that of Canada bluegrass.

Grown alone may yield to 900 lb. of valuable forage per acre. Wild white clover grown alone may yield to 3,000 lb. per acre. A mixture of this clover and Kentucky bluegrass may yield about 5,000 lb. of forage even more nutritious than either of other two yields. Does best on soils with lime.

If Kentucky bluegrass is sown alone, about 40 lb. are used per acre. Weighs 24 lb. to the bushel. As a mixture, usually not over 12 lb. per acre are used. Grown for seed, a good yield may be to 100 lb. of cleaned seed. This grass is perennial and one of best of forage grasses.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Gramineae

Chess, Cheat
Bromus secalinus

Height to 3 ft. Flowering stems erect, rather slender, but sturdy, smooth. Leaves 3-10 in. long, flat, slightly hairy above but smooth beneath. In related soft cheat *B. bordaceus*, whole plant is softly hairy.

Introduced from its native Europe and more or less too generally established throughout United States. Commonest in grainfields and waste places. In fact, its range might be defined as any place where ordinary cultivated grains will grow successfully. It is especially troublesome in the Southwest.

Flowering panicle rather open and nodding, to 5 in. long, with 3-5 lower branches, unequal and drooping. Spikelets to 0.8 in. long, 0.3 in. wide, with awned scales forming a somewhat flattened cluster of flowerlets. Flowers appear in June and July; fruits in July and August. Annual.

Makes such a vigorous growth in winter grainfields that where stand is thin, cultivated grass has no chance. Leaves have some slight value as hay. Nevertheless, it is grown in some places where soil is poor. Plant about 80% water, 11% fiber and ash, 4.5% nitrogen-free content, 2.5% protein, 2% fat.

When young, the plant has considerable value but its competition with more desirable species when mature makes it highly undesirable in most cases. It is eliminated easily in fields by crop rotation and by using clean seed.

Brome Grass
Bromus inermis

Height to 4 ft. Flowering stems arise from creeping rootstocks. Leaf blades smooth, or nearly so, to 0.4 in. wide, to 1 ft. long, long-pointed. Leaf sheaths closed nearly to top. Flowering stems smooth, unbranched, well-supplied with leaves.

A hay grass especially popular from Minnesota and Kansas to eastern Oregon and Washington and occasionally east through Michigan and Ohio, where it runs wild now and then. Introduced along roadsides and on mountain ranges particularly in northern and western parts of United States.

Flowering panicle about 10 in. long, loose and open with spikelets on ends of loose branches. Spikelets about 1 in. long, $\frac{1}{4}$ in. wide, composed of 6-10 flowers, narrow, purplish, usually without awns though not always so. Fruit flattened, boat-shaped, $\frac{1}{8}$ in. long and $\frac{1}{2}$ in. wide, enclosed in scales.

Thought by some that brome grass may someday replace Kentucky bluegrass as a hay and pasture grass, particularly in the Northwest. Others do not agree. Does not thrive in the South and should not be planted south of Kansas. Has long been cultivated in southern and central Russia. Most palatable to cattle.

Excellent in improving worn-out lands. Usual seeding is 15-20 lb. per acre or in mixtures at 6-10 lb. As a seed crop, yield should be between 400 and 500 lb. to the acre. Unfortunately, brome grass seed too commonly has quack grass seed mixed with it.

Orchard Grass
Dactylis glomerata

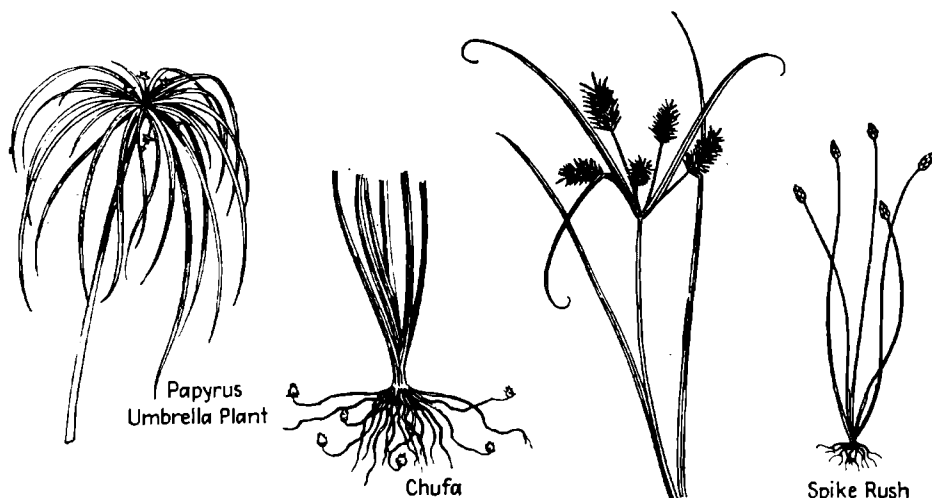
Height to 3 ft. Grows in tufts or bunches, not from a creeping rootstock. Roots deep, penetrating to a depth of at least 2 ft. Fruiting stalks smooth, unbranched, angled. Leaves many, flat, with long sheaths, rough, to 2 ft. long and $\frac{1}{2}$ in. wide, rather conspicuously light gray-green.

Native of Europe. Found in fields, meadows, and waste places from southeastern Alaska to Newfoundland, south to Florida and central California; also found in Asia. Commonly cultivated in England, and known as cocksfoot. Not found in arid and semiarid regions. North Carolina, Tennessee, Kentucky, and Arkansas important centers.

Flowers produced in June, about when red clover flowers, in 1-sided panicles, spikelets containing 3-4 flowers and spikelets being in dense clusters, whole cluster being to about 4 in. long. Grain enclosed in a scale which is about $\frac{1}{4}$ in. long while grain itself is about 0.1 in. long. Perennial.

Seed weighs 14-22 lb. to a bushel; is sown for hay at 35 lb. to the acre or, when mixed, to as low as 6 lb. Most seed is produced near Lexington, Ky.; removed by threshing about 2 weeks after hay is cured. Hay should be cut when plant is in bloom. Remarkably free of disease.

Good for early pasture and excellent for hay. For livestock, food value is fair for proteins, good for minerals, fair for calcium and phosphorus, and fair for carbohydrates. Does not stand pasturage well and a stand that lasts over 4 years with close grazing is exceptional.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Cyperaceae

The sedges have solid stems that are usually more or less triangular. Their leaf sheaths are not split.

Papyrus, Paper Reed
Cyperus papyrus

Height to 15 ft. Flowering stalks strong, erect, smooth, roughly 3-angled, arising from a stocky, woody rhizome that lies horizontally just below surface of ground. Leaves all spring from base, though sheaths on flowering stem resemble leaves. Leaves are mere sheaths at base.

Native of southern Europe, Syria, and Africa but often grown in aquariums and park or hothouse ponds for unique artistic effect. Used as lawn ornaments in California and survives winter in milder parts of South. Of the many varieties, this is one most associated with Palestine.

Tall fruiting rays have great clumps of drooping rays to 20 in. long, that make what appears to be an elevated cushion or stool. Spikelets from 1-1½ in. long, with many smaller, spreading spikelets. Fruit nut-like, 3-cornered, and gray.

Need an abundance of sunlight and air. Highly susceptible to attacks by aphids that deform them. Need an abundance of water but cannot stand a continued jet. Plantings from seeds are made in fall or spring, and seedlings may be well-developed first season.

Plant is famous as source of paper for ancient Egyptians. In fact, name papyrus and paper are practically synonymous. In America, only important use is decorative, young and old plants each being valuable. Probably used in paper making as early as 2400 B.C.

Chufa, Nut Grass
Cyperus esculentus

Height to nearly 3 ft., stout, with fruiting stems and leaves about equal in length. Leaves spring in clusters from horizontal, twisting stems that lie just beneath ground and bear walnut-shaped tubers at their ends.

Found in Europe, Asia, and America from Nova Scotia to Minnesota, from southern Nevada north along Rockies to Alaska and south to Mexico. Grows in low, wet grounds along waterways and frequently spreads into cultivated fields.

Flowers borne in light chestnut or straw-colored clusters about ½ in. long. Many fruits are borne in a single cluster. Most effective reproduction is by tubers that are thrust in all directions from parent plant.

As high as 94% of food found in gullets of pintail and mallards has been nut-like tubers of chufa, some containing 300 or more. Tubers are often known as "ground almonds" and may constitute the best duck food in areas that are flooded.

Plant may be a pest in cultivated lands. Where used for encouragement of wildlife, tubers are planted at a depth of about 1 in. at 1 bushel an acre, usually between April 1 and June 15 in areas where flood waters do not disappear before July.

Spike Rush
Eleocharis sp.

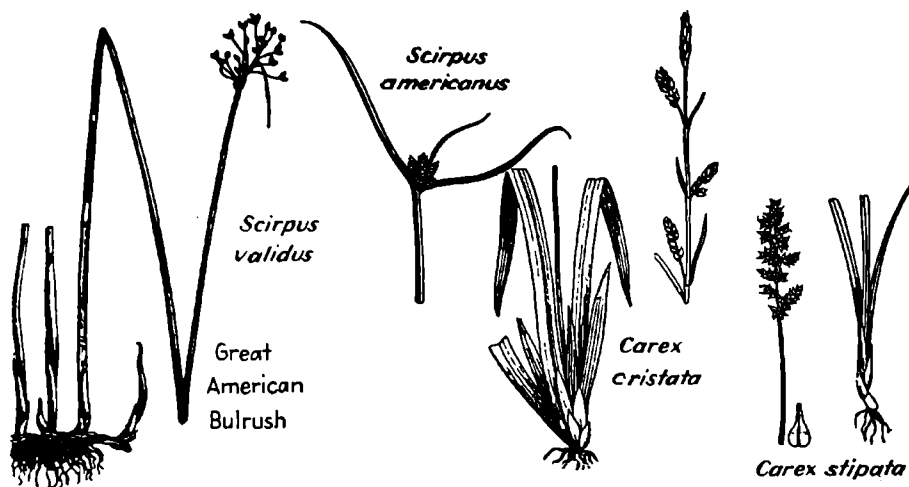
Eleocharis palustris, common spike rush, grows to a height of 5 ft., is round-stemmed, and fruiting stalks terminate in a spike about ½ in. long. Stems to ¼ in. in diameter; there are numerous, horizontal, underground stems from which erect clusters rise at intervals.

E. palustris ranges from Labrador to British Columbia and southern Alaska, south to Florida and into Mexico, thus covering the entire United States. Most species grow at the edge of water and some grow submerged.

Small spike at end of erect stems contains fruits. In *E. palustris*, spike is like a pointed cylinder with scales loose, reddish-brown with white margins and a greenish back. Underground stems also serve to spread plant and in general reproduction. Perennial.

Common spike rushes provide food for ducks and geese over a wide territory. Blue geese and Canada geese may graze on it extensively in the Hudson Bay area, eating both nutlets and vegetative parts. It is probably not so commonly eaten by ducks as by geese.

Where artificial propagation is desirable for raising food for wildfowl, usual procedure is to cut and plant rootstocks. Data on germination of seeds are not available. Most species are of fresh water but salt water supports at least a half-dozen species including *E. palustris*.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Graminales. Family Cyperaceae

Great American Bulrush
Scirpus validus

Height to 8 ft. Fruiting stems arise from stout, horizontal, scaly rootstocks that form dense interlocking mats at about low-water mark. Sheaths at base soft, light green, relatively short, with ragged, almost transparent margins.

Found at pond and stream margins, often in several feet of water, over a wide territory, on this and other continents. Some 150 species over world, including hardstem bulrush, *S. acutus*, river bulrush, *S. fluviatilis*, and the wool grasses including *S. cyperinus*.

Reproduces considerably by spreading of underground or underwater rootstocks that may be broken by flood and washed to a new site. Nudlets dull black, nearly 0.1 in. long, $\frac{3}{4}$ as wide as long, broadly egg-shaped but flattened on one side, borne in clusters, on loose stems, to $2\frac{1}{2}$ in. long.

Bulrushes provide food and shelter for many forms of wildlife of lowlands. *S. fluviatilis* bears 2-3-in. rubers; *S. validus*, fleshy rootstocks that are edible and nutritious for ducks and muskrats. Nudlets of *S. fluviatilis* may be a major duck food at certain times.

Bulrushes serve to anchor loose soil, and to build new land that may be valuable agriculturally. Fleshy rootstocks raw or bruised and boiled, cooked with cornmeal, or dried and made into sweet flour, or thick submerged bases of white, crisp, juicy, young shoots are good food for man at any time.

Sedges
Carex sp.

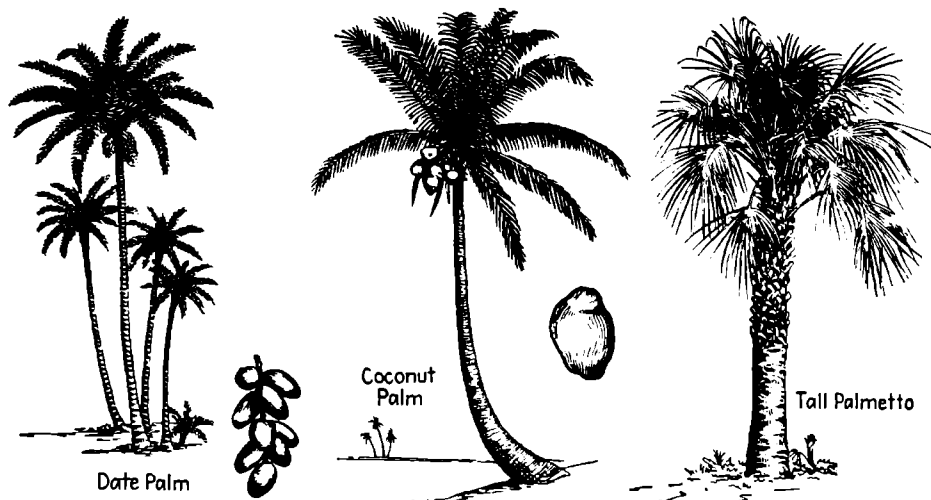
Crested sedge, *Carex cristata*, and awl-fruited sedge, *C. stipata*, are illustrated. Former grows to height of 3 ft., fruiting stalks being longer than leaves. Leaves soft, flat, to $\frac{1}{4}$ in. wide, and spring from numerous sterile shoots that form close to ground. *C. stipata* to $3\frac{1}{2}$ ft. tall, with flowering stalks strongly 3-angled and often winged along angles. Leaves flat, soft, to 0.6 in. wide, and spring from sterile shoots close to ground. Most sedges have solid, usually angled stems that bear fruits. Leaf sheaths not split, and usually leaves are coarser and rougher than those of most grasses.

C. cristata found in wet swales and wet woodlands, from Massachusetts and Vermont south to Pennsylvania and Missouri and west to British Columbia. Probably some 900 species of *Carex* known to science. Most of these are to be found in wet areas. Usually occur in more or less pure stands of a given species and lend a characteristic effect to landscape. Many are a yellowish-green, while others are a distinctly blue-green cast. Some species live in high and dry lands, but they are in minority and not so likely to establish pure strands. Plantain-leaved sedge *S. plantaginea* is common in eastern woodlands.

In *Carex*, nudlets or fruits are enclosed in a papery sac that may be loose or tight. Stamens and pistils borne in separate flowers either in separate spikes, in different parts of same spike, or mixed inconspicuously in same spike. Pollination largely by wind or, in some cases, by insects or by gravity. Sac that encloses fruit is possibly most important structure used in classifying different species. Many sedges reproduce by spread or separation of ordinary vegetative parts. Crested sedge is an example where flowers are in separate spikes.

Beaver, moose, elk, deer, muskrat, bobwhite, sharp-tailed grouse, upland game birds, and waterfowl generally have been reported to feed on sedges. Roots and sprouts are relished by muskrats and other mammals, while the nudlets are more important parts eaten by birds. Most commonly reported species to figure in diet of wildlife is *Carex stricta*. Sedges do not figure as an important forage crop for cattle either as green feed or as hay. They yield rather readily to competition with cultivated plants and are not normally considered as weeds in spite of their frequent abundance.

Sedges are most commonly of importance to man as soil anchors and land builders in lowlands. They prevent undue erosion in flooded lands and provide excellent cover as well as some food for game birds and animals that might otherwise compete with man for more economic species. At least two species are cultivated for their ornamental beauty and are grown in greenhouses or in pots as house plants. These are *C. morrowii* and *C. comans*, former being a native of Japan and latter of New Zealand.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Palmales. Family Palmaceae

Date Palm

Phoenix dactylifera

Height to over 100 ft. Trunk shaggy, rarely perfectly straight or completely erect. Leaves often yards long, more or less erect, loose, open, feather-like, stiff, spine-tipped. Suckers rise freely from and near base, eventually developing roots of their own and making separation possible.

Native of North Africa and Arabia but planted widely through tropical world, particularly in southern Europe and Asia and to some extent in southwestern United States. Family Palmaceae includes about 140 genera and over 1,200 species, some extending range into warmer temperate regions.

Staminate and pistillate flowers on separate trees, pollen normally being spread by wind. One staminate tree is sufficient for 100 pistillate trees. Fruits ripen over long period, some being improved by picking and storing in warm moist place. Seeds or suckers planted at any time in suitable regions.

Favors hot climate but not humid air; can endure more alkali than other profitable tropical fruits and can survive 10°F. for short time but must have hot climate during fruit ripening. Survives condition in Salton Sea, Salt River Valley, and Lower Colorado Valley in United States, and similar conditions elsewhere.

Food value high as nutriment. Has served man as food through ages. Seeds roasted and used as coffee substitute or pressed for oil and pomace used as stock food. Sugar made from sap. Valuable in tropics for providing shade for other plants. Individual fruit clusters may weigh to 30 lb. Annual United States imports may reach \$500,000.

Coconut Palm

Cocos nucifera

Height to 100 ft. Tree with leaves pinnately compound and to 20 ft. long, springing from a common head or restricted area. Trunk tough, fibrous, often curved, and diminishing in diameter to head. Bark rough and fibrous, broken irregularly but often in muscle-like corrugations.

Probably originally from America but widely spread by man early in history. Requires mean annual temperature above 72°F., and unless underground water is available must have at least 40 in. of rainfall a year. Found in California and Florida in United States, in tropics but generally near seacoast.

Flowers borne at head of tree, at 4 years of age in some but more commonly from 7-10 years. Flowers club-like spathes, white or yellow; staminate having 6 stamens and pistillate producing 1-seeded fruits. Fruits may float unaffected in salt water for great time and distance giving wide distribution.

May tolerate salt water and withstand drought, though latter may affect crop for a year or more. Tough fibers of trunk, up to 20% elastic, used in making coir. Subject to a number of insect and fungus pests including a scale, a beetle, rats, and certain crustacea. Nut sizes vary from 3,300-7,100 necessary to produce 1 ton of copra.

Liquor from flower cluster is fermented to a toddy, sugar, vinegar, or yeast. Copra, most important product, used by man and beast as soap, lubricant, and so on. Copra is dried coconut meats. United States has imported as high as 325,000 tons of copra a year.

Palmetto

Sabal palmetto

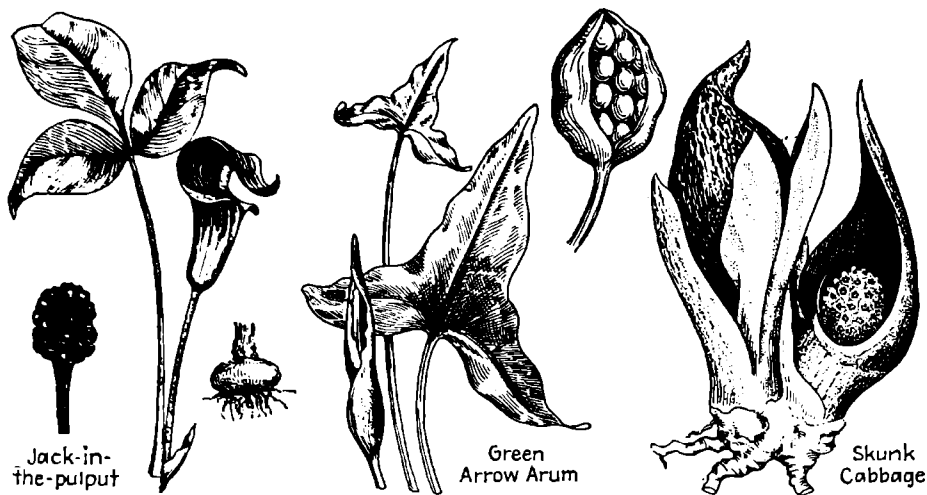
Height to 80 ft. Stem erect, covered in upper portion with leaf bases. Leaves to 8 ft. long, with long, slender base and broad fan-shaped blade, blade being shorter than petiole or base. Leaves arise from a terminal bud, youngest being uppermost and older eventually dropping to stem.

Found from North Carolina to Florida and Bahamas. Forms dense thicket often close to ground where tops have been repeatedly destroyed by fire or otherwise. Favors relatively dry land but grows in sandy stretches close to salt or fresh water. At least 18 species in United States, Mexico, and Central America.

Flower cluster shorter than leaves and produces a number of black, somewhat cherry-like fruits, $\frac{3}{4}$ - $\frac{1}{2}$ in. in diameter. Some palmettos have twisted, underground stems that assist in multiplying the plant and in helping it survive fire and other disasters.

Fanleaf palms include a variety of plants. The California fan palm is *Washingtonia*. In the southeast are the folded-leaved scrub palmetto, the 60-foot cabbage palm of Florida, the saw-edge-leaved saw palmetto, the flat-leaved, low, fibrous-margined dwarf palmetto, and others not here considered.

Palms and palmettos provide excellent cover for wildlife of many sorts. Some make excellent thatching for houses. Raffia of commerce, betel nut of Asia, a sugar, a wine, a vegetable ivory, an oil come from different palms and palmettos. None probably exceed in importance date palms and coconut palm already considered.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Arales. Family Araceae

Jack-in-the-pulpit

Arisaema triphyllum

Height to 3 ft. Leaves 1-2, each of 3 parts, almost like leaflets, with netted veins and unbroken margins, each part to 7 in. long and $3\frac{1}{2}$ in. wide. Leaves arise from a deeply buried, turnip-shaped, solid, bulb-like stem base. Roots spring from base of this structure.

Found in rich, moist woods and thickets, from Nova Scotia through Ontario to Minnesota, south to Florida and Louisiana; up to altitudes of 5,000 ft. in North Carolina. Often found in crevices of rich earth on sides of shaded gorges. Closely related to green dragon, *A. dracontium*, which ranges to south and southwest.

Usually, flowers in a given cluster are either staminate or pistillate. Flowers on spadix or "jack" in "pulpit" (spathe). Spathe hooded, marked with green or purple or brown. Fruit a scarlet berry containing a few seeds, fruit being exposed when mature. Perennial.

Pollination effected by beetles and small flies that visit the "hood," flies commonly being of family Mycetophilidae. Seeds carried by animals or merely drop to ground. Fruit or "turnip," eaten or bitten raw, causes a severe stinging pain in mouth for some time. Flowers April-June.

Fresh turnip reported to have some medicinal properties as an emetic; mixture made of this and of fruit is used to kill insects. Turnip, boiled or baked, then peeled, dried, pounded to flour, heated again, and allowed to stand becomes mild and edible and was an Indian food. Not to be eaten raw.

Arrow Arum

Peltandra virginica

Height to 30 in. Leaves bright green, to 30 in. long, 8 in. wide, with blade like a spearhead, rather thick, strongly veined. Root system a thick tuft of fibers and rootstock from which leaves arise without any apparent stem between.

Found in lake and stream margins or in shallow water, from Maine to Ontario and Michigan, south to Florida, Louisiana, and Missouri. Common in low, flooded lands where there is an abundance of loose, rich silt in some parts of the range. Known as "Virginia wake-robin." Blooms May through summer.

Pistillate flowers cover about $\frac{3}{4}$ length of enclosed spike on which they are borne, remaining $\frac{3}{4}$ being covered by staminate flowers. Enclosing envelope (spathe) to 8 in. long at maturity, thrust under water or close to ground. Fruit green berries, with 1-3 seeds each.

Seeds have been reported by wildlife researchers as being eaten by waterfowl, sometimes assuming importance, but they and plant are rarely eaten by muskrats. In addition to species of arums here considered, there are many others, including the peculiar *Monstera* often seen in banks and in greenhouses.

Starchy rootstock is acrid and poisonous when fresh but may be eaten safely after it has been roasted or boiled a long time. May be made into meal or flour. Berries and fleshy stalk are boiled and were a luxury to Indians. Seeds that have been cooked thoroughly and long may be eaten as beans.

Skunk Cabbage

Symplocarpus foetidus

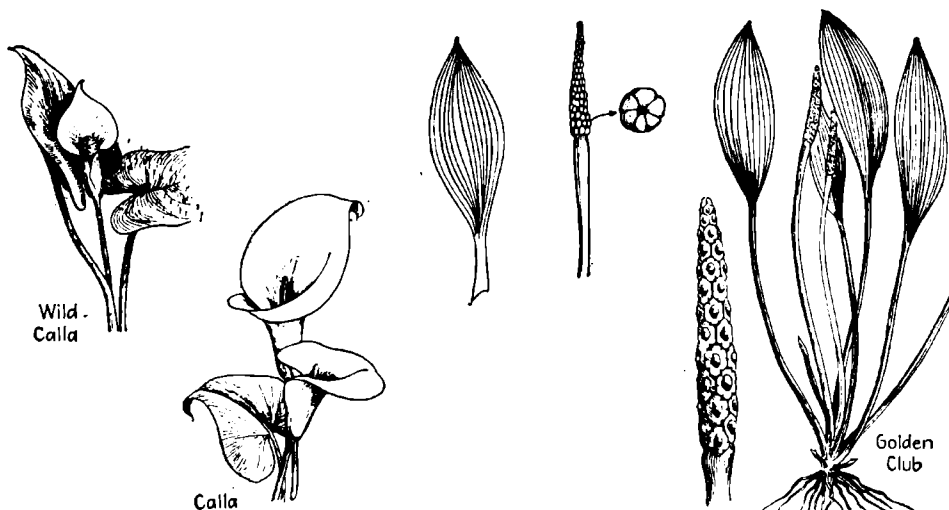
Height to 3 ft. or more. Leaves large, to nearly 2 ft. long and almost same width arising from a stem that elongates as season progresses but in early stages makes plant resemble a cabbage. Rootstocks thick, going deep into soil and bearing whorls of fleshy, fibrous roots.

Common in bogs and moist, open, or wooded lands from Nova Scotia to western Ontario and Minnesota and south to North Carolina and Iowa. Flowers appear early in spring, even thrusting way into icebound soil and frequently being found under snow. Leaves appear after flowers of year have been pollinated.

Flowers bear both stamens and pistils, flowers being crowded onto a spherical structure enclosed in a broad slipper-shaped hood that is green and red or brown. Pollination probably by carrion flies. Seeds borne 1 to a flower, sunken in pulpy fruit that is size of a man's fist.

Name comes from resemblance of leaves collectively to cabbage and of odor of juice to offensive scent produced by skunks. Young roots and flesh of fruit have medicinal properties as an irritant, producing vomiting and even temporary blindness.

Young leaves and shoots may be cooked until tender, discarding one or two waters, which makes them not too offensive as greens. Rootstocks cooked long and thoroughly are palatable, but plant should be used as a food only in an emergency. Remotely resembles poisonous false hellebore, *Veratrum viride* (p. 129).



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Arales. Family Araceae

Wild Calla
Calla palustris

Height to under 1 ft. Leaves with heart-shaped blades, with entire margins, thick, to 4 in. wide, shining, rich green, on long petioles sheathed at base and arising from a thick, horizontal rootstock that is covered with scales and bears fibrous roots at joints.

Found in bogs and shallow waters from Nova Scotia to Hudson Bay, south to Virginia and Iowa. Also grows wild in Europe and in Asia. Known as swamp robin, water lily, or female or water dragon. It is almost always a shade lover and may grow in almost pure stands over a limited area.

Flowers appear in May and June, fruits in July and August. Flowers, at least lower ones, have both stamens and pistils, borne on rather short spike about 1 in. long, backed by a greenish-white spathe about 1 in. wide and 2½ in. long. Fruits red, few-seeded berries, in a large head at maturity.

Pollination helped by water snails as well as by insects. Finding a plant as beautiful as wild calla in a cool, dark bog is a memorable experience.

Of little or no economic importance. While this little flower looks much like the calla lily of Easter fame, the two do not even belong to the same genus. The small wild calla probably yields to cultivation only for adding to beauty of a landscaped pool.

Calla Lily
Zantedeschia aethiopica

Height to 2½ ft. or more. Stocky plant, with smooth, shining green leaves. Blades many, shaped like a spearhead, spongy, and arising from a thick underground rhizome. Often bases of leaves are bristly.

8 species native of tropical and southern Africa and growing commonly in wet, rich lowlands. This species native of the Nile; rose calla, of Natal. Other species, some with yellow flowers and some with the spathe black-throated.

White spathe that opens to one side, flares widely, and tapers to a free tip is well-known. Inside is spadix, covered for most part with many small, naked, crowded flowers, sometimes with stamen-bearing flowers mixed with those that produce 1-3-celled berry-like fruits.

Thrives best in good light, at a minimum temperature of 55°F. In commercial planting, roots are kept dormant in winter in storage at around 45°F., then potted and kept dry until roots start in about 2 weeks. After this, plant may be given water, a higher temperature, and may be expected to bloom in 10-12 weeks. Liquid fertilizer is usually used.

Quite a calla industry in California, where plants may sometimes be grown safely in the open. Main source of revenue is bulbs, grown for shipment and sale to greenhouses, which will develop plant sold in flower shops. Commercially, plants do not thrive in hot, gravelly, or stony soil.

Golden Club
Orontium aquaticum

Height to 2 ft. Leaves erect or floating, depending on depth of water. Sometimes nearly 3 ft. long, with blade about 1 ft. long. Blade dull green above, paler beneath, to 5 in. wide, usually narrowed about equally at base and tip. Rootstocks thick and under mud.

Found in ponds, bogs, and swamps, from Massachusetts to Pennsylvania, south to Florida and Louisiana but mostly near coast. Found up to a 2,000-ft. elevation in Pennsylvania. May form a solid mass acres in extent and may be a pest to boat navigation.

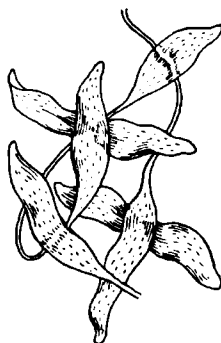
Flowers borne on a stem to 2 ft. long, upper half bearing crowded flowers to form a club up to 4 in. in diameter that becomes much thicker in fruit. Spathe reduced to a scale or bract only 4 in. or less long. Flowers appear in April and May and fruits a month or so later.

Named from Syrian river, Orontes. Size and shape of leaves affected by amount and nature of surrounding water. Grown rather commonly as an ornamental in landscaped pools where it is started by cuttings of rootstocks; rather easily grown.

Bulbous rootstocks may be eaten as food only after repeated boiling and changing water or after roasting to remove acrid juice that makes them otherwise unpalatable. Seeds were gathered by Indians, boiled repeatedly, and then eaten like peas.



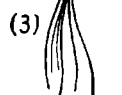
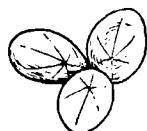
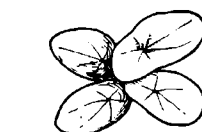
Sweet Flag



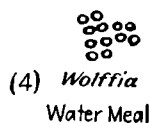
Duckweed (1)

Lemna trisulca

Duckweed (2)



(3)



(4) *Wolffia*
Water Meal

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Arales

Family Araceae

Sweet Flag, Calamus Root *Acorus calamus*

Height to 6 ft. Leaves slender, linear, erect, sharp-pointed, usually under 1 in. wide, with a stiff midrib throughout length, sheathing each other, forming a 2-ranked arrangement. Horizontal, long, branching, aromatic rootstocks bear rather coarse secondary roots.

Found near waterways as along lake shores or streams or in swamps, from Nova Scotia to Ontario and Minnesota, south to Louisiana and Kansas. Also found wild in Europe and Asia. Has many common names including sweet myrtle, myrtle flag, sea sedge, beewort, and sedge cane.

Flowers borne in a spike-like spadix, extending at an angle from erect scape or flowering stem, with spathe merely continuation of structure below spadix. Flowers contain both stamens and pistils. Fruit, when mature, is dry but gelatinous inside and bears few seeds.

Thrives best in moist soil but may be grown in shallow water or even on dry land. A variety *variegatus* with deep yellow stripes is most commonly cultivated, usually by division of underground parts in spring or in autumn.

Pungent, aromatic rootstocks may be bought at drugstores either in natural condition or ground. Used as candy and reputed to have medicinal value. Used in flavorings, and in powdered form mixed in making of sachet powder. Distilled in oil, used in perfumes.

1. Duckmeat *Lemna trisulca*

2. Lesser Duckweed *Lemna minor*

Lemna trisulca forms irregular net of branching fronds, each to 0.4 in. long, green, often without rootlets, usually obscurely 3-nerved, offshoots usually remaining connected. *L. minor* appears as one or more egg-shaped, thin, floating plants, each section to 0.2 in. across, with only 1 root; green above and below.

Both species are found floating on top of quiet, stagnant waters or washed on near-by shores. *L. trisulca* ranges from Nova Scotia to New Jersey, south to Texas and west to Pacific and in tropical and temperate zones. *L. minor* ranges commonly through most of North America.

Reproduction mainly by division of vegetative plants in each of these species. In *L. trisulca*, newly formed sections tend to remain together while in *L. minor* they separate quickly. Flowers are inconspicuous and are borne in a sac at margin of frond; essentially 2 stamens and 1 pistil per unit.

Remarkable for quickness with which they can multiply and cover a considerable surface of water. Either may form a dense mat almost completely covering water beneath. Useful in aquariums in biology class as examples of a quick vegetative reproduction.

Different species are essentially alike in wildlife management, the duckweeds having been reported as serving as food for ducks, geese, muskrats, pheasants, beaver, and other small animals, with 2 species here considered being most frequently mentioned.

3. Large Duckweed *Spirodela polyrrhiza*

4. Watermeal *Wolffia* sp.

These are the largest and the smallest of the duckweed group. *Spirodela* is easily recognized as a floating oval or group of ovals, each to about $\frac{1}{8}$ in. long, green above and purple beneath, with a tuft of many roots beneath. *Wolffia* is so small as to resemble small green dots, not over $\frac{1}{25}$ in. long. It is rootless.

Both *Spirodela* and *Wolffia* are found floating on surface of stagnant waters, often mixed in with *Lemna*. *Spirodela* is common from Nova Scotia to British Columbia and south to North Carolina, Alabama, Texas, and California. *Wolffia* ranges from Ontario to Gulf of Mexico and west to Minnesota.

Reproduction is for the most part by means of vegetative division, which under favorable conditions may be very rapid. Flowers of *Spirodela* are marginal, while those of *Wolffia* are on upper surface or burst through it. They are of course microscopic in each case.

Wolffia is interesting to biologists because it is probably the smallest of all flowering plants; although it may be abundant, it may never be noticed.

Both *Spirodela* and *Wolffia* have been reported as good duck food, with *Spirodela* sometimes constituting a substantial portion of ducks' diet and also often eaten by pheasants.



Pickerel Weed



Mud Plantain



Water Hyacinth

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Xyridales. Family Pontederiaceae

Pickerelweed *Pontederia cordata*

Height to 4 ft. Erect, bright green. Leaves mostly coming from near base from a stout rootstock, thick, dark-green, smooth, with blades broadly triangular, spearhead-shaped, and borne on long petiole, to 10 in. or more long and to 6 in. wide.

Found in shallow ponds and streams or at water's edge, in rivers and bayous, from Nova Scotia to Minnesota, south to the Gulf of Mexico and Florida and Texas. There are several races, based partly on width of leaves.

Flowers borne in a coarse spadix or spike-like structure supported by a small, leaf-like spathe. Spadix bears flowers about 4 in. long. Flowers crowded, weak blue or deep violet-blue, with distinct, yellow-green spot. Stamens, 6, 3 being long. Fruit bladder-like, containing only 1 seed.

Seeds occasionally of value as duck and deer food and plant is good muskrat food. Leaves lose a large amount of water through transpiration and so plant may be undesirable around water reservoirs. It is, however, most attractive and will probably always find favor.

Scientific name refers to a professor of botany at Padua about 1730. Common name refers to fact that plant grows at edge of waters in which pickerel are likely to be found.

Mud Plantain *Heteranthera dubia*

Length to many feet. Usually submerged aquatic, with a slender, forked, flattened stem, joints sometimes being 3 ft. apart. Roots at the joints. Leaves slender, flat, very long, finely parallel-veined. Often has color of dying grass.

Found in still or flowing fresh water from Quebec and western New England to Oregon and south to Cuba and Mexico. While it is usually out in water deep enough to cover it, it sometimes is found growing as a low plant on muddy shores that may be temporarily submerged.

Flower light yellow, inconspicuous, borne singly apparently at the end of a long thread-like tube. Colored part in 6 divisions. Stamens longer than pistil they surround. Fruit a 1-celled, many-seeded capsule. Sometimes 2 flowers are borne together.

Another aquatic that provides some food and much shelter to fishes and other animals of its environment. In some localities it is reported to serve as a good duck food, but it cannot compete with many better species in this respect. Related species have more beautiful flowers.

Of little direct importance to man. Rarely sufficiently abundant to interfere with water transportation, as does its close relative water hyacinth, and not so beautiful as the pickerelweed. It probably is more useful as food for aquatics than either of these relatives.

Water Hyacinth *Eichornia crassipes*

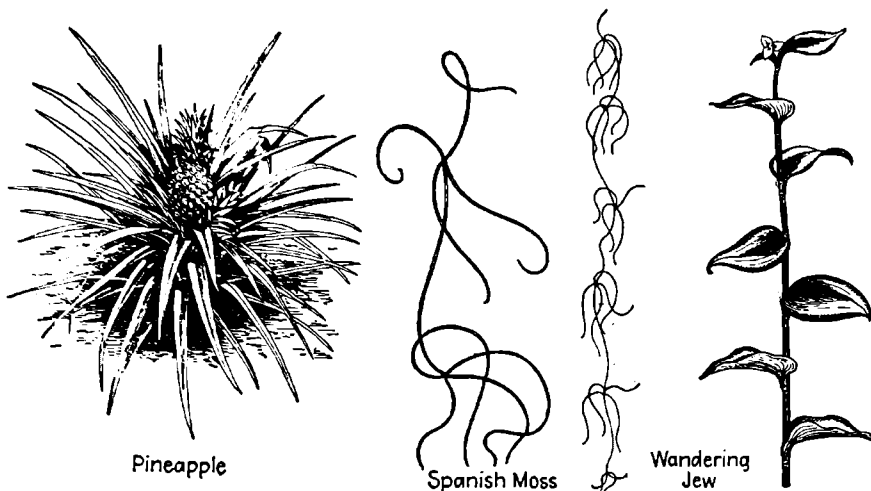
Height to 1 ft. or more above water in which plant floats. Underwater leaves, if on young stems, slender. Leaves at water surface have bases, are air-filled, and serve as floating bladders. Other leaves may be more or less erect with swollen bases. Roots extend into water or soil.

About 6 species, mostly in South America but one from Africa. *E. crassipes* is a pest in Florida and along Gulf Coast and is found as far north as Virginia and Missouri. Is grown as a curiosity in ornamental pools in the North. Brazil is center of abundance.

Flowers borne on erect stem about 1 ft. high, supported by wavy-margined sheath part way up stem. About 8 violet, 6-parted flowers, upper lobe of colored part being marked with dark-blue spot, with a bright yellow spot in middle. One variety has yellow flowers; another, rose-lilac.

Reproduces largely by extension of main plant body. This breaks, floats away, and starts new colonies; process is continued until whole surface of water may be so closely packed that boats can get through only with great difficulty. Not valuable as food for wildlife.

Known in South as "million-dollar weed," not because it is worth that much but because it is estimated that it might cost that much to keep it under control in valuable waterways. Plants grow rapidly. Even in short season in North may cover a considerable space in a small pond.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Xyridales

Family Bromeliaceae

Pineapple

Ananas sativus

Height to 4 ft. Erect, short, stout stem, bearing coarse, spiny-edged, thick, closely crowded, sword-shaped leaves. *Crowns*, leaves coming from top of fruit. *Slips*, small plants formed just below the fruit. *Suckers* develop from axils of leaves close to ground. *Ratoon*, buds developing underground.

Raised chiefly in Hawaii, Cuba, Puerto Rico, and formerly, to limited extent, in Florida. Has been grown outside the tropics, but without commercial success. Hawaii produces 75% of world's canned pineapple and most of West Coast's fresh fruit; Puerto Rico produces most of East's fresh fruit.

Plants are raised from seed only for breeding purposes, as about 12 years are required to mature a plant from seed. Ratoons are usually left to replace harvested crop. Suckers producing fruit in June may produce 5 suckers by mid-September. Slips require a year longer than suckers to produce a crop.

From 8,000-15,000 plants needed to set an acre. May require 18 months to yield first crop of 50-350 crates, but second crop may be double the first and third crop may be even larger. Yield may continue 8-10 years. Fruit harvested a week before it is ripe. Soil must be well-drained but water must be available.

Canning fruit and juices and shipping fresh fruits is big business. Fruit high in sugars of high nutritive and palatable nature but only about $\frac{1}{2}$ vitamin A value in canned pineapple as found in fresh strawberries. Fruits weigh to 32 lb. Pina fiber comes from leaves.

Spanish Moss

Tillandsia usneoides

Length several feet. Usually found hanging in irregular profusion from branches of trees. Stems slender, hoary gray. Leaves scattered, 1-3 in. long, narrow and thread-like. Both leaves and stems are flexible and wave freely in wind from support above. Roots attached to support above.

Found from Virginia to Texas and south, being common in most of its range and usually very conspicuous. Any picture of a southern woodland in moist regions will show Spanish moss. It extends south to southern Brazil.

Flowers solitary, borne in axils of leaves, inconspicuous, with yellow petals bent backward at ends. Reproduction may be by vegetative division of parent plant or by means of seeds that are borne in an inconspicuous capsule.

Moisture, warmth, and sufficient elevated support are necessary for survival of this plant. It does occur to some extent in regions of killing frost and snow. A number of insects, including thrips, are to be found dependent on the plant.

Man uses Spanish moss not only for decoration of his trees in proper territory but for packing material, upholstery stuffing, and, in outdoor living, for making emergency mattresses.

Family Commelinaceae

Wandering Jew

Zebrina pendula

Common wandering Jew is either *Zebrina*, which is a sprawling or hanging plant with leaves that are striped white and green above and blue beneath, or *Tradescantia fluminensis*, which is a prostrate herb, rooting at joints and whose leaves are generally broader. Roots fibrous.

Zebrina is a native of Mexico but is grown commonly in greenhouses and window gardens almost anywhere; in some parts of the tropics is an escape. *T. fluminensis* is a native of Brazil, Uruguay, and Paraguay and is also a common greenhouse and windowbox plant.

Flowers of both species usually have 6 fertile stamens. In *Zebrina*, petals are united into a tube at base at least; while in *Tradescantia*, petals are free of each other or nearly so. In *Zebrina*, calyx tube is whitish and corolla white with red or purple segments. Commonest reproduction by cuttings.

Interesting to teachers of biology because epidermis of leaf peels off beautifully to show stomates, and because hairs found on the stamens show circulation of protoplasm in an excellent manner. They also survive careless treatment well and grow rapidly. Best temperature, 60-70°F.

If these are grown as house plants, they may be "thickened up" by pinching off ends of stems, forcing abnormal branching. Cuttings may be rooted in water before planting in rich, moist, or water-soaked soil. Plants will grow for a long time in water.



Spiderwort.



Day Flower



Rush

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Xyridales
Family Commelinaceae

Order Liliales
Family Juncaceae

Spiderwort *Tradescantia* sp.

T. virginiana, a relatively common species, has green, flat, linear leaves, uppermost of which are somewhat downy. Bracts beneath flowers leaf-like, long, usually extend at right angles from main stem, or upward. Leaves all keeled. Stem unbranched, to 1½ ft. high.

More than 30 species of genus, of which *T. virginiana* and wandering Jew, already discussed, are sometimes cultivated. *T. virginiana* ranges from Maine to Virginia and west to Rocky Mountains. More common in western part of its range.

Flowers in clusters at tip of stem. Sepals thickly covered with hairs. Petals a rich, purplish-blue, to ⅓ in. long, therefore conspicuous. Flowers do not last long and wilt quickly if picked for a bouquet. Pollinated by queen bumblebees who eat pollen.

Tradescantias in general are considered hardy hothouse plants and wild forms seem able to survive difficult conditions. Railroad embankments in Middle West are often blue with their flowers in season. All are easily propagated by cuttings.

Aside from being attractive wild flowers and garden plants, spiderworts are useful in supplying material in biology classes for studying circulation of protoplasm. This is seen easily in hairs found in centers of flowers of many species.

Dayflower *Commelina coelestis*

Height to 18 in. Stems diffusely branching, weak, more or less succulent. Leaves alternate, clasping stem at base, broad, but pointed at tip, parallel-veined, smooth, arising from fibrous or tuberous root that may or may not figure in commercial propagation. Virginia dayflower more slender, 3 ft. high.

Native of mountains of Mexico, with a considerable number of natural and horticultural varieties. About 100 species of commelinas, or about ⅓ of all of spiderwort family. Two of these are grown outdoors in pots as ornamentals. Virginia dayflower, New York to Texas.

Flowers in groups of 4-10 from axils of upper leaves, or 1-2 flowers from axils of lower leaves. Flowers deep blue, although there are white or blue-white variations. 3 sepals, 3 petals, and 6 stamens, of which only 3 are fertile. Fruit a 3-celled capsule.

Dayflowers are propagated by seeds, by cuttings of tuberous root, or by cuttings of stems. Cuttings are made in March, hardened, and then set out. Tubers may be divided when setting out in spring. Seeds may be planted in cold frame in April. Roots should be taken up and stored in sand through winter.

Cultivated commelinas all hardy, some surviving intact while others may die in severe weather; used as garden flowers or as house plants because of attractive foliage, growth habit, and flowers; used as a potherb in Europe.

Rush *Juncus effusus*

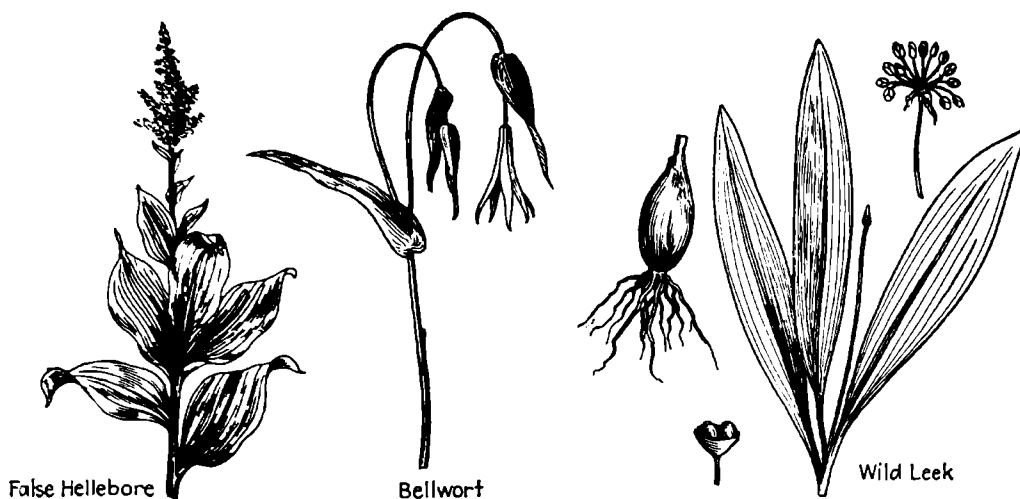
Height to 4 ft. Fruiting stalks erect, arising from creeping, horizontal rootstocks, bearing fibrous roots, and often appearing in tussocks or hummocks. Leaves small, and reduced mostly to sheathing scales.

Native of North America and Europe, being found almost anywhere in North America where soil and water conditions are suitable. Favors areas such as low meadows and pastures, edges of ditches and waterways, and rich lowlands that may become overflowed. Particularly troublesome in Puget Sound area.

Flowers contain both pistils and stamens and have 3 petals and 3 sepals each. Fruit a greenish-brown capsule containing an enormous number of minute seeds each to about ⅓ in. long. Plants may be reproduced by spreading and eventual separation of underground parts or by seeds.

Presence of this plant indicates too much moisture in soil for most cultivated crops. Related path rush of woods may be used as an indication of location of a path. Pith of stems beautiful under a microscope and is used as an example of unique cells. This is Japanese mat rush used in "matting."

Where this plant has to be destroyed as a weed, plants are grubbed, piled, and buried or burned with impression filled or leveled by cultivation. Cultivation of crops on an infested field for 2 years should eliminate plant. Muskrats feed on roots and bases, as do moose. Ducks find shelter in rushes.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Lilies have regular, symmetrical flowers with 6 stamens and a 3-celled ovary containing few to many seeds. Usually there is no spathe.

False Hellebore
Veratrum viride

Height to 8 ft. Stem stout, unbranched, covered with leaves. Short rootstock has many coarse, fibrous roots. Leaves broadly oval, pointed, folded like a plaited fan, clasping at base, slightly fuzzy, to 1 ft. long, to 6 in. wide, upper shorter than those beneath.

Found in wet areas, open or wooded, from New Brunswick and Quebec, through southern Canada and northern United States, south to Oregon and mountains of Georgia. In Adirondacks in New York it is found to an elevation of 4,000 ft. Known also as swamp hellebore, itchweed, tickleweed, earthgall.

Flowers borne in a panicle which is to 2 ft. long, many-flowered, branched, with lower branches drooping. Flowers yellow-green, to 1 in. across. Fruit to 1 in. long and $\frac{1}{2}$ in. thick, smooth, containing many seeds, each to about $\frac{1}{8}$ in. long. Flowers mature in May, June, and July. Perennial.

All parts of plant are poisonous if eaten. Since it resembles edible skunk cabbage, two plants should be differentiated. Has a bad taste and so would not be eaten by animals normally. Poison is due to a mixture of alkaloids such as veratrine, jervine, cevadine, and veratridine.

Yields quickly to cultivation; will not survive drainage that would precede agricultural practices. Plants that persist can be removed by grubbing. Poisoning symptoms are vomiting, foaming at mouth, abdominal pain, tremors, spasms, blindness, death. Treatment calls for heart and lung stimulants, tannic acid as antidote, opium to relieve pain.

Bellwort
Uvularia grandiflora

Height to 20 in. Stem above ground, erect or nodding, forked, smooth, round in cross section, arises from a short rootstock with fleshy roots, and bears leaves that are 2-5 in. long, pierced by the stem, oblong to oval, smooth above but fuzzy beneath when young.

Found from Quebec to Ontario and Minnesota, and south through Georgia, Tennessee, and Kansas, with related species extending the range. Closely related *Oakesia* has leaves that are not pierced by stem. *U. perfoliata* that is smooth throughout is sometimes called wild oat.

Flowers yellow, drooping bells, to $1\frac{1}{2}$ in. long, with 3 distinct yellow sepals, 3 distinct yellow petals, 6 distinct stamens, each with long, narrow pollen sacs and a 3-lobed, 3-celled, capsule-like fruit about $\frac{1}{2}$ in. long. Flowering time April and May.

Bellworts not hardy after shade-producing woods in which they normally live are removed. They sometimes form considerable colonies but rarely if ever occur in as pure stands as many other early spring woodland plants.

Young shoots reported to be as good as asparagus and the roots are supposed to be edible when cooked. Recommended that they be eaten only as an emergency food, however.

Wild Leek
Allium tricoccum

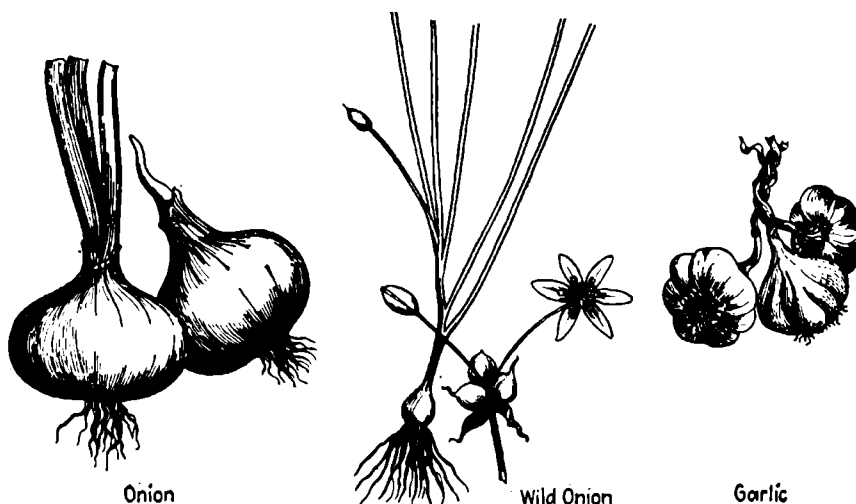
Height to $1\frac{1}{2}$ ft. Stems arise from a deeply buried, pointed bulb that is to 2 in. long. A short, fibrous rootstock may connect a number of bulbs. Leaves erect, to 1 ft. long and to 2 in. wide, appearing early but drying up before flowering time. Leaves narrowed at each end.

Found from New Brunswick to Minnesota, and south to North Carolina, Tennessee, and Iowa. Often found in extensive beds of almost pure stands in rich, damp woodlands. It also grows well in gravelly or sandy pastures. It is a native plant.

Reproduction by bulbs or seeds. Flowers appear after leaves of year have wilted, in June and July; on top of stem or scape, to 15 in. high. Group of flowers at first enclosed by 2 bracts. Flowers white, to $\frac{1}{4}$ in. long. Fruit, a capsule, to $\frac{1}{4}$ in. broad. Seeds smooth, black spheres. Pollination by bees.

Sometimes persists as weed in open, sandy fields. Has leaves with a strong leek or onion odor that if eaten by cattle may affect taste of milk and butter produced. Because of this, it is essential that plants in pastures be kept in control if not destroyed.

Occasionally, leaves are eaten by persons. They give the breath a never-to-be-forgotten fragrance that is much worse second- than first-hand. Used sparingly, they add flavor to otherwise tasteless foods.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Onion
Allium cepa

Height of flower stalk to 4 ft., hollow, swollen below middle, and much taller than leaves. First-year leaves basal, hollow, developing bulb in late season. Some varieties produce new bulblets from bases of larger ones; some produce bulblets instead of seeds in flower; some produce regular flowers and seeds. Mostly biennial.

Native of Asia, probably from Palestine to India; mentioned in Bible and reported as one of things Israelites longed for when lost in wilderness. It has been cultivated in America since 1629. In acreage, leading states raising onions commercially are Texas, New York, Michigan, California, Colorado, New Jersey, Massachusetts, Indiana, Idaho.

Flowers, many, lilac or white, in large, loose cluster springing from spreading bracts. Stamens 6; pistil 3-celled, with seeds black, spherical. May be grown directly from seeds, by using "sets" from tops of some varieties, by bottom sets springing from underground bulb, or by sets grown from seeds in hot-houses. In North, commonly grown from seeds.

In South, seed is planted in September at rate of 30 lb. per acre, but 17 lb. of seed per acre of hotbed should produce enough sets to plant 10 acres in rows 14 in. apart. Transplanting generally gives better results than direct growing. Large sets, to 1 in. in diameter, may produce a yield of 94 bushels to the acre, while small sets under $\frac{1}{2}$ in. may yield but 9 bushels.

Most important American bulb crop, averaging for 20 years around 160 100-lb. sacks per acre, worth a total of around 17 million dollars for each 5-year period. Food value is high and popularity of onion as food is well-established and sustained, so there is a dependable market.

Wild Onion
Allium canadense

Height to 2 ft. Bulb, usually 1-2 in a place, to 1 in. high, covered with a fibrous net. Leaves linear, remaining active through time of flowering, arising from basal bulb, flat or flattish, to $1\frac{1}{2}$ in. wide and to $1\frac{1}{2}$ ft. long. All dark-green, and with strong onion taste.

Found in meadows and brushlands, from New Brunswick to Minnesota, south to Florida, Louisiana, Texas, and Colorado. In Virginia may be found at an elevation of 2,500 ft. Essentially an early summer plant.

Reproduces by bulbs, bulblets, and seeds. Bulbs divide underground. Bulblets appear at end of erect stem or scape where flowers would be found; are more common than flowers. Flowers white or pinkish, with stamens just enclosed by surrounding parts. Pollination by bees, butterflies, flies, and moths.

Since this plant if eaten by cattle affects milk and butter produced, it is necessary to keep it under control or eliminate it in pasture lands. It does not withstand competition of cultivated crops and so can be controlled relatively easily. Bulblets are interesting to botanists.

Indians formerly harvested these plants for use through the year. Green tops may be eaten raw or may be used to improve the flavor of soups, meats, and salads. They may be cooked in several changes of water if the flavor is too strong to be acceptable to the eater.

Garlic
Allium sativum

Height to 1 ft. or less. Leaves narrow, or keeled, not round in cross section as in the onion, under 1 in. wide, long-pointed. Bulb composed of several parts enclosed in a silky whitish or flesh-colored sac. Unique in group and is common product in grocery stores so it should be well-known.

Native of southern Europe, but grown in gardens rather widely, particularly where peoples of Mediterranean extraction are to be found. Soil favored is an ordinary garden soil of loose, relatively rich loam.

In gardens, reproduction is primarily by planting the little bulbs, or "cloves," or "bulbils." If these are set out in spring, they mature in early autumn; if in the fall, they mature in spring or summer. Bulbils replace flowers, which are purple.

If soil is too rich, plants may produce too much of relatively useless top and too few valuable bulbs. If top growths are broken down when they reach maturity, this situation may be helped. Cloves are set in drills from 4-6 in. apart.

Garlic is for sale in stores in strings of bulbs or in separate cloves. It is used in flavoring meats, soups, and salads, the amount depending on choice of eater and artistry of cook. It can "break" a meal as easily as "make" one. Garlic has antiseptic and bactericidal properties.



Tiger Lily



Wild Yellow Lily



Madonna Lily

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Tiger Lily

Lilium tigrinum

Height to 4 ft. Stem purplish-brown, covered with cobwebby substance. Leaves 75-100, crowded, each 4-6 in. long, more or less clasping at base, narrow, straight or curved, and with bulbels in their axils. Bulb to 4 in. in diameter, spherical, white or yellow, or tinged with purple or red.

Native of China and Japan but naturalized as an escape in Maine and New York. Several natural and cultural varieties, one of them having double flowers, some being paler in color of flowers; some being larger in every way.

Flowers horizontal, or slightly declined or drooping, opening wide, without a tube remaining, orange-red or salmon-red, with black spots, and with apparently long pistils and stamens. From 1-15 flowers on a plant, each 3-5 in. in diameter and with conspicuous red anthers on the stamens. Lower buds open first.

One of easiest of all lilies to grow. Hardy, survives neglect, and yet is as beautiful as most of its relatives. Grown in old-fashioned gardens and shown in pictures as typical of the fence in a New England home. Bulbils from leaves produce flowers in 3-4 years. Plant fall or spring, 10 in. deep in rich, loose soil.

Bulbs planted in June should produce flowers about Oct. 15. Those potted in July may give flowers at Thanksgiving time. Potted tiger lilies need much fresh air and comparatively little water to thrive. Bulbs formerly imported from Japan seemed to be among the best.

Wild Yellow Lily

Lilium canadense

Height to 5 ft. Stem slender, smooth, light green, with leaves in whorls of 4-10, there being 4-8 whorls, leaves being to 4 in. long and to $\frac{3}{4}$ in. wide. Usually no leaves on lower part of stem. Bulbs borne an inch or so apart, on a stout rhizome, each to $1\frac{1}{2}$ in. in diameter.

Found in meadows and open woodlands, from New Brunswick to Ontario and Minnesota, south to Missouri, Georgia, and Alabama. Probably less than 100 species of genus *Lilium*, but most of them are beautiful graceful flowers, too attractive for their own good in the wild. Common also in bogs.

Flowers nodding on ends of stems arising from uppermost whorls of leaves. From 1-10 flowers per plant, each to 3 in. long or wide, bright orange-yellow, with purple-brown spots, with red anthers on stamens. Pollination mostly by honeybee, and leaf-cutting bee. Perennial.

Probably commonest of wild lilies growing within its range, and, because of its beautiful, nodding flowers, always popular. In related Turk's-cap lily lower leaves are whorled but others are crowded along stem, and outer flower parts bent farther back.

Fleshy bulbs of these lilies were used by Indians to thicken soups and were eaten cooked. However, now no reason for destroying these beautiful flowers merely for sake of eating them.

Madonna Lily

Lilium candidum

Height to 4 ft. Stem erect, deep-green, smooth, bearing from 60-100 leaves that are to 9 in. long and to $2\frac{1}{2}$ in. wide, lower ones being larger and appearing horizontally in fall; shortest being just below flowers. Bulb globular, white to yellow, to 4 in. in diameter.

Native of southern Europe and southwestern Asia, from Corsica to Caucasus Mountains and Iran. This lily is widely grown by florists and is one of the commoner flowers sold in pots at Easter. Believed to be lily referred to in the Bible. Commonest outdoor white lily cultivated.

Flowers held horizontally or nearly so; trumpet-shaped, widening upward; 3-20, each to 9 in. long, to $2\frac{1}{2}$ in. wide, with yellow anthers; tube, pure, waxy white. Fragrance delicate and pleasing. Anthers golden. Seeds germinate in 21 days, live about 2 years but require several years to reach flowering stage.

For Easter, bulbs are potted in December in heavy, fibrous, slightly acid soil. Individual bulbs set in 5-6 in. pots. First months 54-56°F., then raised gradually to 60°, this bringing flowers in 13 weeks. Usually, 6 weeks required after buds show; though at 75° this may be shortened to 2 weeks.

L. candidum is used for Easter when season is late; *L. longiflorum*, when it is earlier. *L. candidum* is popular with florists for Mother's Day and for Memorial Day. *L. regale* may be brought to flower in 65-70 days with first 10 days at 70° and the remainder at 60°F. Plant lice and a rust are worst pests.



Day-lily



Tulip



Sego Lily
Mariposa Lily

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Day Lily
Hemerocallis fulva

Height to 6 ft. Leaves basal, to 1 in. wide and to over 2 ft. long, sword-shaped, erect, but not reaching higher than flower-bearing stem. Roots coarse, fibrous, producing new shoots that form a pure stand even against competition.

Found from France to Japan and probably was introduced into Europe early. In America, found commonly from New Brunswick to Virginia and Tennessee as an escape and probably generally wherever flower gardens are maintained. Needs no winter protection.

Flowers short-lived, fading and closing at end of a day; borne at top of erect flowering stems, with 6-12 flowers on a single stem, not fragrant, orange-red 3-5 in. long, with a slender 1-in. tube. Fruit oblong, 3-celled, 3-angled, and many-seeded. Perennial.

In general, orange day lily resembles yellow day lily except for color of flowers. Yellow day lilies have narrower leaves. All are unusually free from insect and fungus pests and survive conditions of cold, drought, and flood. Divide every 4-5 years.

These lilies mark last evidence of many an early homestead and their presence in quantity usually means that near by is the foundation of an old home. They are used for quick effects in new gardens but are sometimes difficult to keep in control or to eradicate.

Tulip
Tulipa gesneriana

Height to 2½ ft. Leaves, 3 or more, on lower part of stem, to 4 in. broad and 1 ft. long, smooth, parallel-veined, with entire margins, uniformly green and usually with edges curved upward in early stages at least. Leaf surfaces vary in different varieties.

Native of Russia and Asia. Developed for garden purposes extensively in Holland and Denmark and imported into America for a long time. Possibly was first grown in Europe in Austria in 1554, in England in 1577. Now one of most popular spring garden flowers. Some 60 species and many more varieties.

Flowers, 1 to a plant, erect, 2 in. or more high, and, when open, twice that width, not fragrant. Typically, flowers are scarlet with a blackish-purple center, but may be yellow, or white, or almost black. Anthers purple or yellow. Fruit a capsule that produces many seeds.

Best known of fancy varieties are Darwin tulip, a tall, late-flowering variety with deep colors; and parrot tulip, with segments of flower crisped or wrinkled around edges. In open, tulips are planted in fall, mulched with straw, and should bloom by spring.

Tulip bulbs may be potted in the fall and stored in a cool place to get roots established. This should take 8-12 weeks at 45°F. Then, forcing at 70-80°F. for 3 weeks should produce blooms, or at higher temperatures, blooms may be forced in 10-14 days. Lowering temperature holds flowers.

Sego Lily, Mariposa Lily
Calochortus nuttallii

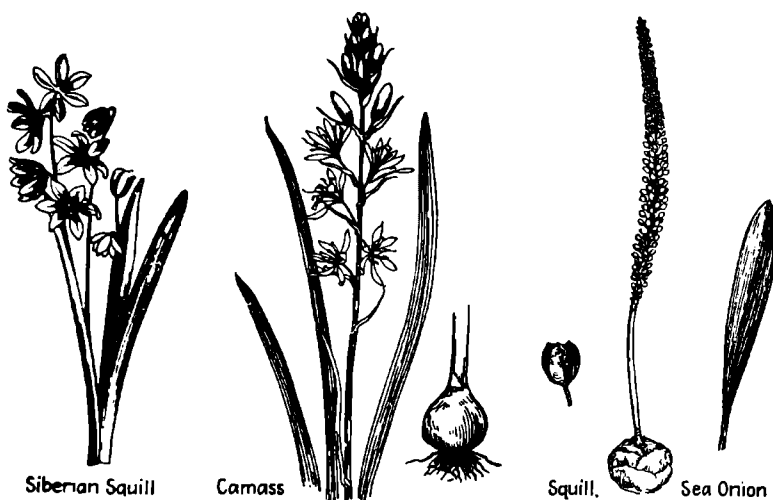
Height to 2 ft. Stem stiff, erect, and arising from a bulb base. On erect stem, usually only 1 leaf. Leaves ashy green and surprisingly small in comparison to size of flower. A vigorous underground system in which nourishment is accumulated for time of flowering.

Found from the Dakotas and Nebraska, west and south to New Mexico and California. Other species have a more limited range and are less well-known. Especially characteristic of sagebrush deserts such as are common in Great Basin.

Flowers to 2 in. long, white, with greenish-white or a lilac tinge, and with a purple spot or band above the yellow base. From 1-5 flowers on a single stem. Mariposa lily, *C. venustus*, common in some Western national parks, is a close relative.

Most members of genus can withstand severe cold but do not prosper where there is much freezing and thawing at short intervals. Globe tulips of gardens are members of this genus as are meadow tulips and butterfly tulips. Sego lily is the State flower of Utah.

Underground portion has been used as food, and early Mormons in Utah found it valuable in this respect. As garden flowers or house plants, blooms can be forced in the spring by potting the plants in the fall and keeping them growing slowly at a temperature of 50°F.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Siberian Squill
Scilla sibirica

Height to 6 in. Flowering stalks, 1-5 rising from buried, scale-coated bulb. Leaves rather succulent, to 5-6 in. long and $\frac{3}{4}$ in. broad, blunt. *S. peruviana* reaches to height of 1 ft.; English bluebell, *S. nonscripta*, to 1 ft.; Spanish bluebell, *S. hispanica*, to 20 in.; *S. amoena*, 6 in.

S. sibirica comes from Russia and southwestern Asia; *S. peruviana*, from the Mediterranean region; *S. nonscripta*, from Great Britain and vicinity; *S. hispanica*, from Spain and Portugal. Star hyacinth, *S. amoena*, comes from mid and southern Europe, as in Germany and Italy.

Flowers of *Scilla* have only 1 nerve in each of the conspicuous segments instead of 3 as in *Camassia*. They appear early, with the leaves. *S. peruviana* has over 50 flowers, while others rarely have to 20. *S. sibirica* has 3 or less flowers to a flowering stem; *S. amoena*, 4-6; and *S. nonscripta*, at least 12.

Squills are grown mostly for their early appearance and their hardy qualities. Siberian squill blooms just for a few days; English bluebell may bloom from April-June. For most part, they need not be disturbed for years though a good top dressing in fall may do no harm.

Scillas may be raised or forced in greenhouses by putting a half-dozen bulbs in a 5-in. pot with soil, leaving them cool until growth starts, and giving them little water. When growth has started, temperature may be raised and amount of water increased.

Camass
Camassia quamash

Height to 3 ft. Stem erect and arising from a coated bulb, with leaves arising from base. Leaves under $\frac{3}{4}$ in. wide, but to 2 ft. or even more long. Some forms are much lower; some are slender, while others are stout. Bulbs ordinarily produce no offsets.

Native of North America, where there are 5-6 species ranging from British Columbia and central California to Arkansas and Texas. *C. quamash* found from California to Utah, and north to British Columbia. Favors meadows that are very wet in winter and spring and very dry in summer.

Flowers, 10-40 on a single stalk, with white to blue, showy parts, each segment being 3-5-nerved rather than 1-nerved in *Scilla*. Pedicels or individual flower stems, shorter than flowers, and showy parts of flower not usually evenly arranged.

Camassia may be cultivated in ordinary garden soil, although it normally thrives best in heavy soil that has much moisture in early season. Planted 3-4 in. apart, 6 in. deep early in fall. Seeds develop into plants bearing flowers in 3-4 years. Excellent as cut flowers.

Camass bulbs formerly constituted a major portion of plant foods of the Vancouver Indians. Bulbs collected and stored are either boiled, roasted, fried, or cooked in pies with other food. A reasonably good molasses may be made from camass bulbs. Collecting is done in spring and summer.

Squill, Sea Onion
Urginea maritima

Height to 3 ft. Flowers appear before leaves. Leaves come from underground bulb that is unusually large, being to 6 in. through and rather fleshy, smooth, to $1\frac{1}{2}$ ft. long and to 4 in. wide, somewhat shining; reaches a weight of 15 lb.

From the Canary Islands to Syria, and in South Africa. Is grown extensively in homes in southern Europe and can survive long periods without water. About 75 related species, ranging from Europe to India and through tropical Africa to South Africa.

Flowers bloom in summer or autumn in England, appearing sometimes as early as July but always before leaves. From 50-100 flowers on a common stem, each $\frac{1}{2}$ in. across, whitish, with greenish-purple areas present. Seeds strongly compressed, winged, borne 10-12 in each section of fruit.

Sea onions are not hardy outdoors in the North and are not grown much in America. Confused with *Ornithogalum caudatum* under common name of sea onion, and with *Scilla* under common name of squill.

Bulbs contain to 22% sugar. Used in making croup medicine, as cathartic, as an emetic. Also used in rat poison that seems to have a fatal effect only on rats. Flowers should have greenhouse popularity, since they last long.



Grape Hyacinth



Hyacinth



Bow-string Hemp

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Grape Hyacinth
Muscaria botryoides

Flower stem to 1 ft. high, in center of cluster of 6-8 leaves that spring from a small, egg-shaped bulb and are 1 ft. or more long and $\frac{1}{3}$ in. wide, dark rich green and grass-like. Name refers to resemblance of flowers to a bunch of grapes and similar fragrance.

Native of southern Europe but planted widely in flower gardens and naturalized in many near-by places. Seems to do well in any kind of soil but best in ordinary garden soil of a rich, loose loam, in the sun or not. Most frequently planted in borders in clumps.

Flowers appear in early spring, outdoors or indoors, may be made to flower in late winter. There are 20-40 tiny blue urn-shaped flowers to a stalk, each with 6 petal-like parts, about $\frac{1}{4}$ in. long, the uppermost sterile. Commonest method of reproduction is by division of bulbs.

Indoors, plant 6-8 in a flat 6-in. pot; cover with $\frac{1}{2}$ in. of soil of $\frac{1}{3}$ sand, $\frac{1}{3}$ rotten manure, and $\frac{1}{3}$ garden soil. Set this away for 2 weeks, in the dark, at a temperature of 60-70°F. until started, then bring into light and warmth. Outdoors, bulbs are set 1-2 in. apart in fall for early spring flowers. In gardens, bulbs are set in masses rather than singly.

Popular, hardy garden flower of paths and rock gardens. Garden-set plants should be reset every 3 years to avoid undue crowding of new bulbs that appear as offsets from old.

Hyacinth
Hyacinthus orientalis

Flowering stem to 1 ft. high, smooth hollow, succulent, arising from a large 2-in. sheathed, nearly spherical bulb. Leaves 8-12 in. long by $\frac{1}{2}$ - $1\frac{1}{2}$ in. wide, many-nerved, lengthening after flowers mature. Roots fibrous, developing from base of bulb.

Native of Asia Minor, Greece, and northern Italy, but developed for gardening mostly in the Netherlands and similar western Europe territory. Roman hyacinth is smaller, early, and comes from southern France. All favor deep, rich, well-watered soils.

Flowers in many colors, double or single, bell-shaped, drooping, with a swollen base and spreading segments, 30-40 to a stalk, to $1\frac{1}{2}$ in. across, unusually fragrant; with 3 colored sepals, 3 similarly colored petals, and 6 stamens, of which 3 are longer than the other 3. Perennial.

Favored varieties include for single flowers the blue Baron Van Thuyll, the white Alba Maxima, the red Florence Nightingale, and the yellow King of the Yellows. Double flowers include the yellow Bouquet d'Orange, the blue Charles Dickens, the white Prince of Waterloo, and the red Bouquet Tendre.

Bulbs received in September may be potted 1 bulb to a 4-in. pot, with soil $\frac{1}{3}$ garden soil, $\frac{1}{3}$ manure, and $\frac{1}{3}$ sand, about $\frac{1}{2}$ in. below surface, watered and set under straw or kept at 45-50°F. May be forced in 2-4 weeks at 75-80°F. with good moisture, then cooled down to 50°F. for longevity. Grown in France for making perfume.

Bowstring Hemp
Sansevieria sp.

Leaves 8 ft. long, to 3 in. wide, springing directly from root, since plant has no stem above ground. Leaves rounded on back, with dark-green, longitudinal lines on back and lighter green, transverse lines on inner face. A number of varieties differ by color and banding of leaves.

Some 50 species, for the most part native of Africa and Asia, although many are suitable for cultivation in North America and are to be found as house plants, since they survive abuse and lend themselves to limited floor space and exposure to the sun. Named after a Prince of Sansevero who was born in Naples in 1710.

Flowers whitish to yellow, in an open cluster. Tubes swollen at base, with 6 stamens attached to throat. Fruit is a berry, with 1-3 seeds. Occasionally plant will flower as a household plant, in which case its fragrance is most welcome. Closely related species include cylindrical-leaved *S. cylindrica* and flat-leaved *S. thyrsiflora*.

In India, Queensland, Java, and South China, plant is grown for its fiber, which is soft, pliant, silky, very strong, and easily extracted by machines. It is uniformly good throughout length of leaves. 1 ton of leaves will yield 50 lb. of fiber, with 1 acre of land yielding $13\frac{1}{2}$ tons of fresh leaves. Propagation is simple and by roots.

Known in many homes as "snake plant." Also known as "murta" or "moorva." Probably commonest potted plant in hotel lobbies of United States, and, next to geranium, ranks high as a house plant. Most commonly cultivated in the Bahamas. Slightly more difficult to handle as a commercial crop than is sisal.



Asparagus



Asparagus Fern



Lily-of-the-valley

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales. Family Liliaceae

Garden Asparagus *Asparagus officinalis*

From 4-10 ft. tall, with spring shoots succulent and thick, and summer growth slender and tough. Leaves reduced to scales that are pressed closely to stems, with slender stems assuming role of leaves in mature plant. Stems smooth, much-branched. Roots of many cord-like fleshy parts spring from a more or less common center. Perennial.

Native from Britain to central Asia and Africa, where it grows wild on coasts and in sandy regions. Escapes cultivation in America and may be found in a variety of places. Does best on deep, loose soil; sandy loam best for early crops; and should at all times be well-drained since plant cannot long survive submergence. Usually planted 8 in. deep.

Plants bear either staminate or pistillate flowers, rarely those with both stamens and pistils. Flowers bell-shaped, borne in groups of 1-4, in axils of leaf-like stems. Staminate flowers yellow-green, $\frac{1}{4}$ in. long; pistillate, smaller, and with 3 longish stigmas. Fruit a berry, under $\frac{1}{2}$ in. through, turning from green to red and bearing about 3 seeds.

If soils are acid, liming may be necessary. Doubtful if use of salt in controlling weeds is desirable. Seeds germinate in 2-6 weeks at 86°F.; may be soaked to 3 days. Staminate plants yield 25% more crop, but pistillate yield larger spears, a year-old staminate plant yielding 26 spears, first spears appearing, in East, at 2 years. Should produce for 20 years with good care. Enemies, rust and beetles.

May yield over 2 tons per acre. Price increases $\frac{1}{4}$ base price for every inch of succulent shoot above 3 in. Food value of shoots is decreased with removal of summer tops. Grading, washing, packing, bunching may increase price. Fresh shoots, preferably green; those to be canned, often blanched. Fresh shoots toughen rapidly first 24 hours, unless cooled before shipping at ordinary storage temperatures.

Asparagus Fern *Asparagus plumosus*

Height to over 4 ft. Stem thin, twisting, smooth, with a few short spines, drooping. Leaves flat, green, leaf-like branchlets, 1 in. long and $\frac{1}{4}$ in. wide in clusters around slender stem. Root system with short white tubers.

Native of South Africa. Many of its varieties are purely horticultural and have been developed by greenhouse methods. There is a dwarf form, *nanus*; a compact form, *compactus*; a robust form, a climbing form, and so on.

Flowers in loose clusters of 1-4, at the ends of twigs, pinkish or whitish, with calyx like corolla, and each composed of 3 segments that are united into a bell-like form. Fruit a berry, $\frac{1}{4}$ in. across, bright red, and with 1-3 seeds that germinate in 3 weeks.

Commonest method of reproduction, by dividing tubers so that each section has one or more "eyes." Plants are set in dark in sandy soil and given liquid manure. At 60-70°F. they grow rapidly. Seeds should be soaked for 24 hours before being planted, and in a year should develop large plants.

Plants are started in summer; ends are pinched off to thicken vegetation. Ammonium sulfate at rate of 1 oz. to 2 gal. of water given twice a week stimulates growth. Must be kept in shade in warm hot months. Greenhouse white fly is bad pest. Always a ready market for this plant.

Lily of the Valley *Convallaria majalis*

Height to 1 ft., but usually less. A slender rootstock branches profusely and gives rise to leaf clusters that rise in 2's. Each leaf long, elliptical, with the base lengthened to a petiole, smooth, not toothed or cut on margin, parallel-veined, uniformly dark-green.

Native of Europe and Asia, and in the mountains from Virginia to South Carolina. Escaped from cultivation in many places and appears as a survival in abandoned homesites, particularly in the East. Does best in shade in relatively dry spots and often forms pure stands.

Flowers attractive white bells, nearly $\frac{1}{2}$ in. across, borne commonly more to one side of the erect or drooping flower stalk, each stalk bearing a few to many uncrowded flowers. Fruit a red, few-seeded berry. Petals like the sepals, and there are 3 of each. A most delicate fragrance.

If plants are potted, they are set in equal parts of sand, garden soil, and humus, using 8-10 "pips" in a 6-in. pot. Potted plants are kept in dark for first 2 weeks and are then brought into full sun and a temperature of 65-70°F. Pots are probably best set in water.

Flowers characteristic of old homesteads of longer settled parts of country and cherished by some as belonging to bridal bouquet. In greenhouses, may be forced to bloom at almost any time but commonest is January and February. Plants outdoors usually bloom in June. Yield the poison convallarin.



Plantain Lily



Aspidistra



St. Bernard Lily

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Plantain Lily, Funkia
Hosta plantaginea

Height to 3½ ft. Flower stems tower above spreading foliage. Leaves to 10 in. long and to 6 in. broad, long-petioled, with prominent ribs, strong side ribs in oval blades of leaves, and a short sharp point at end. Known to many as "funkia." Root strong and cord-like.

Native of China and Japan but introduced and well-established widely in the United States and Canada as a hardy plant for the flower garden. Group might well be represented also by the blue-flowered plantain lily, *Hosta caerulea*, whose leaves are greener and more shining. Seeds flat, black, winged at end.

Flowers to 4 in. long, trumpet-shaped, showy, waxy white, fragrant, appearing above foliage. Showy segments, 6. Stamens, 6 and long. Flowering period through August into September, with pollination effected by insects. Blooms second year from seeds and is perennial.

Prefers rich, deep, moist soil in partial shade; easily sunburned or destroyed by frost. Seeds sown as soon as ripe. More common to divide root system in fall or early spring. Water through dry weather. Mulch lightly with well-decayed manure after ground freezes. Remove mulch in spring after frost danger has passed. Relatively free from insect pests.

One of more desirable of old-fashioned garden flowers, the appearance and fragrance of which somehow mean mid-summer to all who have sought the odor of orange issuing from the delightfully attractive though short-lived flowers. Unusually fast maturing from seed, when compared with many of its relatives.

Aspidistra
Aspidistra elatior

Height to 20 in. Leaves arise from long rhizome that is ringed with finer roots. No tall flower stalk. Leaves, many, to 24 in. long, to 4 in. wide, narrowed at both ends, with a smooth, unbroken margin, parallel-veined; sometimes variegated and most attractive.

Native of China, Java, and Japan, with 3-4 species represented in that area and up into the Himalayas. It needs little sun, stands neglect as a house plant well, and is generally popular in hotels and in greenhouses.

Flowers borne singly, at surface of ground, beneath leaves, and often are not seen even though they are produced. 3 sepals and 3 petals, all colored alike a purple-brown, and all united into a tube. Fruit, 4-celled.

In common practice, plant is propagated by separating underground parts. It does best at temperatures between 60-75°F. It needs only a moderate amount of water and has few insect or fungus pests. Aphids sometimes develop but they are easily removed.

The plant's ability to withstand fumes from gas stoves, to survive dry air, dust, and small amount of sunlight of homes and hotels makes it a popular house plant. *A. variegata* must have poor soil to do well.

St. Bernard's Lily
Anthericum liliago

Height to 3 ft. Flowering stem unbranched and usually leafless. Leaves, many, to 1 ft. long, and very slender. Underground parts, a tuber-like rhizome, bearing numerous, smaller, branching roots; underground or ground surface branches or stolons help in reproduction.

Native of southern Europe and northern Africa. Widely grown as outdoor ornamental largely because of ease with which it is maintained. More than 50 different species in genus and 100 in closely related genera found in Europe, Africa, and America but mostly in Africa.

Flowers star-shaped, whitish, not showy, about ¾ in. across, borne loosely on long, woody stalks. Petals and sepals alike, totaling 6, usually with greenish tips. Fruit round and 3-celled. Seeds, 3-angled.

Needs little light. Does best where temperature remains around 60-70°F. Has few insect or fungus pests, so needs little care. Little water needed, but should be available in generous quantities when plant is in full bloom. If grown outdoors, needs winter protection with a mulch or something similar.

A relatively common garden plant. New plants are usually made either by bringing one of stolons to ground, letting it take root, and then cutting it off, or by cutting off a bunch of small leaves at end of a natural stolon and giving it independence.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales. Family Liliaceae

Adder's Tongue, Trout Lily *Eryciorhizon americanum*

Height to about 10 in. Leaves arise from deeply buried bulb. Young plants bear 1 leaf; mature plants, 2. Leaves to 1 ft. long, green, or green with purplish-brown markings, pointed at each end, with unbroken margins, smooth, usually curving toward upper surface.

Found from New Brunswick to Florida, west to Arkansas and Minnesota, with close relatives extending range; one found on West Coast. Favors moist woodlands, near streams, and may persist for some years in open after forests have been cut. Some species prefer open country to woodlands.

Flowers produced seventh year after seed has been shed; first 2 years, little showing, and, in intervening years, only 1 leaf per plant. Many offshoots are formed from bulb and help in multiplying the plant. Flowers yellow, nodding, with segments to $1\frac{1}{2}$ in. long.

E. denscanis, the dogtooth violet of Europe, as well as the native species, may be planted in wild gardens and in rock gardens. It is smaller than this species. Pollination by bees such as queen bumblebees, by cabbage butterflies, sulfur butterflies, and by some flies of the early season.

Bulbs edible, either raw or boiled. Beauty of flowers is such that bulbs should be eaten only in emergency when other food is not available. If flowers must be picked, leaves should be left, since loss of leaves and flower in a single year may destroy a plant that took 7 or more years to mature.

Clintonia *Clintonia borealis*

Height to 15 in. Leaves rising from base only, commonly 2-5, but usually 3, oval, thin, to $3\frac{1}{2}$ in. wide and to 10 in. long, blunt-pointed. Rootstock slender, branching, and giving rise to erect leaves and their clusters.

Found from Newfoundland to Manitoba south to North Carolina and Wisconsin, and to an elevation of 4,500 ft. in Virginia. Usually in moist woodlands and brushy bogs, frequently in acid soil. There may be many plants in a restricted area if they have not been destroyed.

Flowers drooping, greenish-yellow bells, in loose clusters of 3-6, on slender, upright stems, reaching to height of 15 in. Each flower to nearly 1 in. long, and relatively inconspicuous largely because of color. Fruit a blue, many-seeded berry, to $\frac{3}{8}$ in. in diameter. Flowers in May and June.

A plant of the wild places in much of its range. A shade lover. Has been called such names as bearrongue, cow-tongue, dogberry, wild lily of the valley, and Clinton's lily. Its scientific name is from Governor DeWitt Clinton of New York, an early naturalist.

This is a plant that poet and nature lover instinctively like. The poet speaks of "the rare blue of Clintonia berries" and says more to the nature lovers than all the academic description to be found in a botanical manual. It is reputed to have some medicinal properties.

False Lily of the Valley *Maianthemum canadense*

Height to 7 in. Stem erect, arising from a slender rootstock, zigzag, and bearing 1-3 leaves, but usually 2. Leaves to 3 in. long, broadly egg-shaped, but pointed at free end and heart-shaped at base, base sometimes enclosing stem. Stem and leaves smooth or finely hairy.

Found from Newfoundland to Northwest Territory and south to North Carolina, Tennessee, Iowa, and the Dakotas, reaching an elevation of 5,000 ft. in Virginia. It favors moist woodlands and brushlands, often where soil is poor but more commonly where it is loose and deep.

Flowers, small, with segments only about $\frac{1}{8}$ in. long. Showy part of flower (perianth) in 4 parts. Stamens, 4. Ovary and fruit, 2-celled. To 12 flowers on a common axis. Fruits pale red, speckled berries appearing in summer. Flowers appear from May to July.

The name means Mayflower. It also bears the name of bead ruby, referring to the fruit, or one leaf referring to the fact that young plants bear only 1 leaf. It is a dainty flower, fortunately too small and insignificant to invite the average flower collector to add it to a bouquet.

This plant is used sometimes in table garden terrariums and occasionally in shaded rock gardens where a touch of green or some red jewel fruits are needed. Plant lends itself to care in such a garden but is not so hardy as other plants similarly used.



False Solomon's Seal



Solomon's Seal



Indian Cucumber

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

False Solomon's Seal
Smilacina racemosa

Height to 3 ft. Stem slender, arched, slightly or strongly angled, finely haired above, arising from a thick, fleshy, horizontal, rough rootstock, and bearing numerous oval or pointed, elliptic leaves, without petioles, usually to 6 in. long and to 3 in. wide, conspicuously parallel-veined.

Ranges from Nova Scotia to British Columbia, south to Georgia, Missouri, and Arizona, reaching an elevation of 2,500 ft. in Virginia. Found in moist, open woods, usually where there is a good rich, rather deep soil, but sometimes on thin soil of hillsides where there is sufficient moisture.

Flowers borne in a many-branched cluster at tip of stem, crowded but not into a compact head or spike. Flowers to $\frac{1}{2}$ in. broad, whitish, appear in May to July. Fruit to $\frac{1}{4}$ in. in diameter, a red, fragrant berry commonly speckled with purple. Persists to fall.

Name false Solomon's seal comes from superficial resemblance of plant to Solomon's seal. In this plant, however, flowers are borne at tip of stem instead of along it, and underground part is rough and lacks regular leaf scars that give Solomon's seal its name.

Berries edible either raw or cooked. Root has been used in home remedies but it is not recognized officially as having great medicinal properties. Plant is a thing of beauty, either in flower or in fruit and helps make a woodland a place of joy for the nature lover.

Solomon's Seal
Polygonatum biflorum

Height to 3 ft. or more. Stem wand-like, slender, smooth, zigzag in the upper parts, arising from a horizontal, thick rootstock, that bears on upper surface seal-like scars of stems of previous years, and on lower side, rather coarse, sparse roots. Leaves to 4 in. long and to 2 in. wide.

Found from New Brunswick to Ontario, to western Michigan south to Florida and Tennessee, with closely related species extending the range. Found mostly in damp, open woodlands where soil is rich and either deep or well supplied with moisture in spring months.

Flowers borne in clusters of 1-4, hanging on short stems from axils of leaves, each one to $\frac{1}{2}$ in. long, greenish, and relatively inconspicuous. Fruits dark-blue berries, to $\frac{1}{4}$ in. in diameter, persisting until late in season unless eaten by some animal.

Name springs from seal-like impressions made on rootstock by scars of earlier stems. Rootstock branches rather freely, and it is interesting to trace the development of a group of plants by uncovering the rootstocks and counting the years' growth.

Early spring plant has been eaten, either boiled like asparagus or raw. Indians have eaten starchy roots and were said to cultivate the plant for this purpose, although this is doubtful. Early French colonists in America were said to have eaten the roots apparently only to avoid starvation.

Indian Cucumber
Medeola virginiana

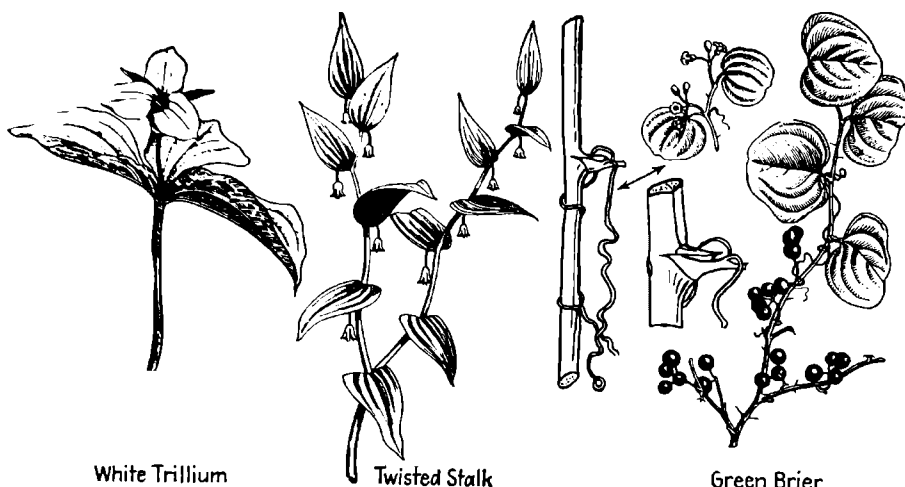
Height to 2½ ft. Stem erect, arising from a horizontal, whitish, edible rootstock that is to 3 in. long. Stems relatively slender, stiff, and bearing whorls of leaves at remote intervals. Leaves to 5 in. long, to 2 in. wide, those of lower whorl being much larger than those of upper.

Found from Nova Scotia to Minnesota, south to Florida and Tennessee. Only 1 species in genus and this is confined to eastern North America. May be relatively abundant but never too much so. Found in rich, open woodlands, where there is usually a deep, loose soil.

Flowers borne on short, inch-long stems from axils of leaves of uppermost whorls, and are held, either erect or drooping, in flower or in fruit. Exceptionally long styles, and segments of conspicuous part are nearly $\frac{1}{2}$ in. long. Fruit a dark-purple berry, $\frac{1}{2}$ in. in diameter.

This perennial plant is too pretty to destroy for the delicious morsel cucumber-shaped and cucumber-flavored rootstock it provides. Difficult to see how anyone could eat rootstock without destroying plant, and for that reason its use as food should not be encouraged.

Indians are said to have eaten rootstock regularly. If you must try eating it, never collect a plant unless there are 3 others in a 3-ft. radius, so plants will not be destroyed.



White Trillium

Twisted Stalk

Green Brier

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales. Family Liliaceae

Trillium

Trillium grandiflorum

Height to 18 in. Stem stout, erect, arising from a deeply buried, irregular bulb, easily broken, and bearing at top a whorl of 3 leaves, each to 6 in. or more long, and nearly half as wide, with rather prominent branching veins. Stem and leaves smooth and dark-green.

Ranges from Quebec to Minnesota, south to North Carolina and Missouri and found at elevations up to 5,000 ft. in Virginia. Favors rich, moist woodlands with a deep, loose soil, and will not long survive sun coming with destruction of woods. It will grow in shade by houses.

Flowers erect or nodding, composed of 3 green sepals, each to 2 in. long, and 3 petals each to 3 or more inches long, that are white at first but change to blue or pinkish with maturity. Stamens have anthers about $\frac{1}{2}$ in. long. Fruit, a berry 1 in. long, red or black.

One of most beautiful woodland flowers of late spring. Has many equally attractive relatives but none have pleasant odors. Wake-robin or red trillium, *T. erectum*, has a flower with a most offensive odor. The painted trillium, *T. undulatum*, with red and white flowers, is popular with wild-garden enthusiasts.

Leaves considered by some outdoorsmen to be edible but plant is too attractive to be destroyed for food. It makes a hopeless bouquet because it lacks fragrance and wilts quickly. No excuse for collecting it for bouquets and thus ruining a beautiful woodland. "The wake-robins trinity sign."

Twisted Stalk

Sprengelia roseus

Height to $2\frac{1}{2}$ ft. Stem erect, or nodding, arising from a stout, fibrous, root-covered rootstock, or rooting from semiprostrate stems. Stem may be branched, somewhat fuzzy, ridged, and twisted. Leaves rather evenly spaced along stem, to $4\frac{1}{2}$ in. long, pointed at free end and egg-shaped toward base.

Found from Newfoundland to Manitoba and Oregon, south to Michigan and Georgia, occurring in Virginia at an elevation of to 5,600 ft. Found in same kind of moist woods in which Solomon's seal, trillium, and Indian cucumber are found, where there is a rich, deep, well-watered soil, at least in spring.

Flowers borne in axils of leaves, with 1-2 to an axil. They are on short stems to 1 in. long, are rose-purple in color, with slender parts of calyx and corolla to $\frac{1}{2}$ in. long, and usually hang loosely downward. Fruit, a cherry-red, translucent berry. Perennial.

Pollination probably by visits of bumblebees and bee-like flies. A closely related plant has greenish-white flowers, and leaves whose bases closely clasp the stem. Both are conspicuously branched and by this character quickly separated from Solomon's seal and spikenard.

This is one of attractive woodland flowers. It has no value as part of a bouquet and since plucking the top may mean death of the whole plant, it should be left undisturbed where possible.

Greenbrier

Smilax rotundifolia

Stem woody, winding, and climbing, covered with prickles that are stout, straight, or sometimes slightly backward-curved or sometimes absent. Stem round, green, arises from a long, tuberous rootstock. Leaves on petioles, to 6 in. long, oval but pointed at free end, with 3-5 prominent veins. Blades to 6 in. long.

Found from Nova Scotia to Minnesota, south to Florida and Texas, growing in rich lowlands in woods and thickets, or more particularly along borders of woodlands. This assists in making dense thickets almost impenetrable.

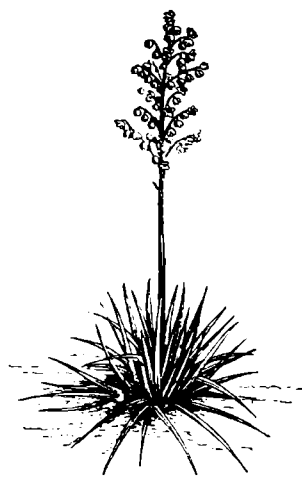
Flowers on short stems, springing from a common point in clusters of 6-25, whole group supported by a common stem. Sepals and petals together total 6 similar structures, with recurving tips. Fruit a berry, to $\frac{1}{4}$ in. in diameter, black, 1-3-seeded, matures first year.

In much of its range, this and other species of *Smilax* are the only woody monocotyledons. This should not be confused with the smilax of the florist. There are approximately a dozen species of *Smilax* in the northeastern United States, none of them being of any great economic importance.

A related species, *Smilax officinalis* of Honduras; another, *S. medica* of Mexico, and a third, *S. ornatus* of Jamaica have roots which when dried yield the sarsaparilla of commerce. Sarsaparilla is rarely used except in combination with such oils as wintergreen.



Joshua Tree



Spanish Bayonet



Dracena

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Liliaceae

Joshua Tree
Yucca brevifolia

Y. brevifolia, height to 40 ft. Spread to 20 ft. Branching, with disc-like bases, from which spread small, tough roots. Leaves crowded near ends of stout branching stems and persistent. *Y. gloriosa*, Spanish dagger, height to 8 ft. Leaves to 2½ ft. by 2 in., with stiff, red tips.

Y. brevifolia found in deserts where there is at least an 8-10-in. annual rainfall, sometimes forming forests. Found in Nevada, Utah, Arizona, and parts of California. *Y. gloriosa* found along Atlantic Coast from South Carolina to Florida, in dry sandy areas.

Joshua tree may or may not flower each year depending on temperature and rainfall. Formation of flowers stops growth in that direction and causes branching. Wind and animals distribute seeds. Spanish dagger has lily-like flowers that are greenish-white to red, 3-4 in. across, appear in summer, hang in clusters.

Joshua tree is parasitized by boring beetle, *Scyphophorus yuccae*; by butterfly larvae, *Megathymus yuccae*; and by other insects. Night lizard, *Xantusia vigilis* is entirely dependent on it for food and shelter. At least 25 species of desert birds known to nest in it.

Near Palm Springs is a Joshua Tree National Monument of several square miles designed to save these unique trees from destruction. Indians used fine red roots in basketry. Of Spanish dagger, there are at least a half-dozen varieties recognized by gardeners, usually on leaf form and color.

Spanish Bayonet
Yucca filamentosa

Adam's needle, height to 12 ft. but no stem except flower stalk. Leaves not rough-edged, 2½ ft. long and 1 in. wide, sharp-pointed, with long curly threads along edges. Spanish bayonet, height to 25 ft. Trunk to 3 ft. Leaves 2½ ft. long and 2½ in. wide.

Adam's needle native from South Carolina to Mississippi and Florida, but planted extensively through much of the United States including New York, Minnesota, and similar Northern states. Spanish bayonet native of West Indies, and around the Gulf north to Virginia and south into Mexico.

Flowers of Adam's needle borne in tall, loose, open arrangement, hanging like white bells, each to 2 in. long, waxy. Fruit a capsule with rounded angles and frequently with insect borings showing. Spanish bayonet, flowers to 4 in. across, white, with purple tips, bell-shaped. Fruit black to purple, to 4 in. long, fleshy.

Pollinated by Pronuba moth that thrusts the pollen into the pistil where it will be effective, and lays her eggs in the ovary that will ripen food for her young. Number of seeds ripened by pollination act of moth is in excess of number eaten by moth larvae. Pollination may be easily effected by man.

Wood of many yuccas is favored by boy scouts for equipment to make fire by friction. The plants have a deserved popularity as ornamentals. Juice of some yuccas is fermented for making of an alcoholic beverage similar to pulque. The fiber "palma istle" comes from immature yucca leaves.

Dracena
Dracena fragrans

Tree-like, to 20 ft. high, branched or not. Leaves weak, shining green, to 3 ft. long and to 4 in. wide, recurved, narrowed at base, and gradually narrowed at free end into a sharp point. Many varieties based in part on different color patterns in leaves, some highly decorative, others plain.

Native of Guinea, or more definitely, Upper Guinea, but known throughout the world as a potted plant in hotel lobbies, in tropical gardens where the climate is suitable, and at weddings, banquets, and funerals where a green effect is desired in a hurry.

Flowers to ¾ in. long, clustered in open panicles that are to 1 ft. long. Flowers yellow, with narrow sepals and petals. Fruit a small, orange-red berry. Flowers not often seen and so plants are usually classified by characters apparent in leaves. Most Dracenas are long-lived.

At least 14 species and many more varieties of Dracenas are cultivated by greenhouse folk. One of most interesting plants in its natural environment is dragon tree, *D. draco* of Canary Islands, and the Teneriffe dragon tree, which is 70 feet high and famous as one of oldest of trees.

Of great value in interior decoration. *D. cinnabari* of East Asia exudes a red resin known as "dragon's blood" that was used extensively in the eighteenth century to stain dyes and varnishes used in making violins. A similar resin is sometimes obtained from American Dracenas.



Daffodil



Polyanthus
Narcissus



Jonquil

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales. Family Amaryllidaceae

Daffodil

Narcissus pseudo-narcissus

Height to 18 in. Grows from a deep bulb that is to 2 in. or more in diameter. Flowering stem smooth, semisucculent, easily broken. Leaves, 4-6, all starting from base; flat, smooth, to 18 in. long and to 1 in. broad, sometimes with a whitish bloom.

Native from western Europe to Sweden to England, Spain, and Austria. More popular varieties include Golden Spur, Empress, and Ajax. Favors deep, loose, very wet soil but will grow in grass meadows either in open or in shade of near-by trees.

Flower, 1, on end of flowering stem, with a trumpet to 2 in. long and a frill of petals that are relatively narrow. Flower pale yellow, held horizontally, pointing somewhat upward, or drooping. In the large-crowned *Narcissus* trumpet or crown is as long or longer than segments.

For blooming indoors, bulbs are planted 1 to a 4-in. pot, in a mixture of $\frac{1}{2}$ sand, $\frac{1}{2}$ garden soil, and $\frac{1}{2}$ manure, and kept in dark until rooted first, at around 45°F.; then, after rooting, temperature is raised to 65° and water is supplied in abundance. Placed in sunshine when flowers are about to open.

"I wander'd lonely as a cloud
That floats on high o'er vales and hills,
When all at once I saw a crowd,
A host, of golden daffodils;
Beside the lake, beneath the trees,
Fluttering and dancing in the breeze."

—WORDSWORTH

Polyanthus Narcissus

Narcissus tazetta

Height to 20 in. or more. Flowering stalk distinctly flattened, both leaves and flower stalk rising from a bulb that is often to 2 in. in diameter. Leaves 4-6, to $1\frac{1}{2}$ ft. long and to 1 in. broad, parallel-veined, flat and somewhat grass-like, but more succulent.

Native from Canary Islands to China and Japan. Widely established as a house and garden plant. Grown in homes and schools from one end of America to another, wherever there are 10-cent stores to supply intriguing bulbs. Related poet's narcissus comes from France and Greece. About 30 recognized species.

In *N. incomparabilis*, crown is about half length of segments, while in other grass leaved narcissi it is shorter, except in daffodil. *N. tazetta* bears 4 or more flowers on a single stem, crowns not crisped. In *N. biflorus*, usually 2 flowers on a stem, crisped crowns; In *N. poeticus*, only 1 flower to a stem with crisped, red-edged crowns.

N. tazetta may be potted to flower before Christmas. In winter, about 6 weeks are required to bring a bulb to flower; but in spring it may be done in 3 weeks. *N. poeticus*, poet's narcissus, and others are potted late in September in a fibrous, medium loam, a 6-in. pan holding 6 bulbs then "heeled in" for early winter.

Heeled poet's narcissus if kept at 50°F. should develop roots by January, then forced at 50-55°F. until buds are free, then raised to higher temperatures, but nights should be 60° or less. This will produce flowers in 3-4 weeks. Christmas blooms should be forced from mid-November, if potted in September.

Jonquil

Narcissus jonquilla

Height to $1\frac{1}{2}$ ft. A deep bulb produces 2-4 leaves, that look rush-like rather than grass-like, are almost round in cross section, and with a narrow channel on one face. Leaves to 18 in. long, glossy, dark-green, and semi-succulent, easily broken. Flowering stem not flat as in narcissus.

Native of southern Europe and Algeria, but hardy in such states as New York where it has established itself in or near old homesteads and persisted long after other signs of human habitation may have disappeared. Favors loose, deep soil, where there is much moisture in spring.

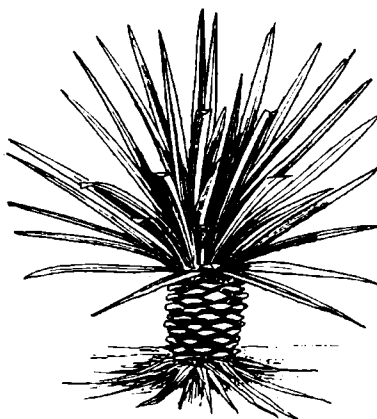
Crown of flowers small, much less than half as long as segments back of it. 2-6 flowers on a single stalk, held horizontally or drooping. They are yellow throughout, most fragrant, and with a slender rear tube to about 1 in. long. Crown not over $\frac{1}{8}$ in. long.

Popular varieties include General Pershing, and most fragrant *Regulosi*. Related species include *Campernelle jonquil*, *N. odoratus*, whose leaves are not quite round in cross section; the hoop petticoat daffodil, *N. bulbocodium*, in which crown of flower is as long or longer than segments behind.

All of narcissus group produce beautiful flowers, popular with house-plant lovers and with outdoor flower gardeners. They bring results rather quickly after initial care has been given and this makes them popular with amateurs. They are relatively free from insect and fungus pests.



Snowdrop



Sisal Hemp



Yam

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales

Family Amaryllidaceae

Snowdrop

Galanthus nivalis

To 10 in. high. In snowdrop, stalk supporting flowers is solid; in snowflake, *Leucojum*, it is hollow. Leaves in snowdrop, only 2-3; in snowflake, many. In *G. nivalis*, leaves are to 9 in. long and to $\frac{1}{4}$ in. wide. Bulb to 1 in. thick, with sheath slit down one side.

Native from central and southern Europe, to the Caucasus, with different varieties in different areas and of course with some different horticultural varieties. At least a dozen species of snowdrops. Generally favor cool, moist, shady areas, often forming beds in and near lawns.

Flowers single, on a slender, nodding, flowering stem, with outer segments white, to 1 in. long, blunt, veiny, and inner segments about half as long, white with green in notches. One flower for about every 10 plants. Blooms in spring but a related species blooms in the fall.

First of showy flowers of year. Since they may be produced in great abundance at a time when there is no competition, they are usually most welcome. By midsummer, they have flowered and leaves have almost completely disappeared. Bulbs are set about 3-4 in. deep, preferably in loose soil, and in masses.

Bulbs are usually cheap. Plants seem to be popular in some areas and less so in others. Giant snowdrop, *G. elwesii*, has flowers to $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. wide. It seems to be gaining in popularity everywhere.

Sisal Hemp, Henequen

Agave rigida

Leaves 8-10 ft. long, average 6 ft. by $4\frac{1}{2}$ in. wide, by $\frac{1}{2}$ in. thick, with a rough, green skin and pulpy interior mixed with fibers; about $3\frac{1}{2}$ -5% of leaf is fiber. Weight of leaf, 1-2 lb. Stem erect, coarse, and, in cultivation, conspicuous, with diamond-shaped leaf scars, cylindrical, barrel-shaped.

About 300 other species in genus including century plant or blue aloe *A. americana*, small-leaved aloe *A. angustifolia*, and others. Sisal hemp also comes from *A. morrisii* and *A. vivipari*. Mauritius hemp comes from *Furcroya gigantea*. *A. rigida* is cultivated in Bahamas, Cuba, Mexico, Florida, and northeast India. Native of Yucatan.

Shoots planted 4 ft. apart, in rows 12 ft. apart. In 4-5 years, or when leaves assume horizontal, first leaves may be cut. Plants allowed to bear 25-27 leaves and yield 12-15 a year cut at intervals. If leaves are not cut when mature, plant may send up 8-10-ft. flower stalk and die. Properly handled, a plant may yield for 14 years in rocky soil, sometimes 1,500 leaves.

A bed of semidecomposed coral rock with hot, dry air, is best environment. In native Yucatan, a plant may yield 20 crops over a span of 25 years. If one plant in an area is allowed to produce its flower stalk, near-by plants may, strangely enough, do the same and die, so a plantation requires care to have continued yield. 600-1,200 plants to an acre.

Leaves are worked when green and fiber is removed by machines, but juice attacks wrought iron. Yellow leaves yield inferior fiber. Fiber whiter, flatter, and less pliable than manila. It is used in making ropes, nets, hammocks, and cordage. Some sisal is extracted by steeping leaves in water 10 days after drying for 4 days and then beating fiber out.

Family Dioscoreaceae

Yam

Dioscorea alata

Climbing vine, with winged or fluted stems. Leaves heart-shaped, but rather long-pointed at free end. Chinese yam *D. batatas* may have a stem 30 ft. long. Tuber of *D. alata* may be 8 ft. long and weigh 100 lb., though it is usually smaller. It also has aerial tubers. *D. batatas* has 2-ft. tubers.

D. alata, native of South Sea Islands and India but is cultivated widely throughout the tropics. It is becoming more important in America. It should have a deep soil but can withstand drought unusually well. *D. batatas* will survive New York winters. Stems of Chinese yam are round, not winged.

Reproduction is essentially by tubers that may continue to increase in size for years. In Chinese yam, small tubers are produced in leaf axils that if planted will produce in 2 years large edible yams. Flowers of yams either pistillate or staminate, with a plant producing one or the other. Seeds, winged.

In commercial practice, yams are grown from tubers, seeds, or stem cuttings, and there are many varieties of the different species. One of the most interesting is a yam from Hawaii that produces large edible, aerial tubers. It is grown along the Gulf of Mexico.

Yams are commonly baked, boiled, or ground into flour, dried, stored, and used in the making of starchy foods of many sorts. In the Southern states, they are raised chiefly as food for stock, but they are relished by many humans and, properly cooked, are delicious.



German Iris



Blue Flag



Gladiolus.

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Liliales. Family Iridaceae

German Iris
Iris germanica

Height to 3 ft. Stems branching, usually with 2 flowers at top, one on a short, and one on a longer lower branch. Rhizome stout, creeping, and, for most part, exposed, with numerous roots coming mostly from lower side. Leaves, broad, stiff.

Native of central and southern Europe; German origin implied by the name is definitely disputed. Many varieties of the species have been developed and it hybridizes with some others. It prefers rich, well-drained, limestone soils, endures half-shade and much drought, and suffers with heavy winter mulch.

Flowers large, showy, purple, yellow, white, or of intermediate or mixed hues. Conspicuous parts of 3 upright standards and 3 drooping "falls." Above the "brush," on the falls, are stamens covered by a sterile part of style of pistil, stigma being beyond end of stamen.

Rhizomes are best divided in July and August. They are planted horizontal to surface, about 8 in. apart, and deep enough to be half-covered with earth pressed close around divisions. Water is needed during the blooming period and weed competition should be kept down for best results.

Excellent garden and path flower. To control crown and pod borers, spray with lead arsenate and destroy infected part, wash contaminated rhizomes with weak potassium permanganate. Dust parts affected by leaf blotch with sulfur, and burn parts affected by sclerotic rot.

Blue Flag
Iris versicolor

Height to 3 ft. Stems round in cross section, often branched, and usually leafy. Leaves erect, shorter than stem, to 1 in. wide, like pointed swords, slightly curved, parallel-veined. Rhizome horizontal, thick, fleshy, and root-covered, roots being fibrous and light-colored.

Found from Newfoundland to Manitoba, south to Florida and Arkansas, mostly in and at edges of marshes, wet meadows, and in open wet brushlands where sun can reach the ground. Not usually in pure stands as are some other plants of same general environment.

Flowers several, usually violet-blue, with yellow, white, and green, the segments being generally more slender and smaller than in most of cultivated species and varieties. Fruit a 3-lobed, oblong capsule, to $\frac{3}{4}$ in. long, with seeds in 2 rows in each cell, and each to $\frac{1}{2}$ in. broad.

Rootstock contains irisin which causes indigestion in humans or cattle, but this is rare because roots have an offensive taste. Skin diseases may be caused from handling iris roots. It has been assumed that death results from calves eating the roots.

Flower attractive. Leaves provide some shelter for aquatic game. Supplies little food to any animal and because of this is inferior to other species that give both food and shelter. Orris root of commerce comes from root of *Iris florentina* and is used as perfume and in flavoring. It smells like violets.

Gladiolus
Gladiolus sp.

Height to 5-6 ft. Thick, flattened, scaly corms of stems, with papery, scaly covering, produce erect stems that bear linear, sword-shaped, slightly curved leaves, parallel-veined, with rather prominent ribs and regular margins. Roots thick and fibrous.

Most important species came from South Africa but some came from Mediterranean region and some from Asia Minor. At least 200 natural species and thousands of horticultural varieties. Hardy plants that do best in rich, well-drained, limestone soils cannot stand drought and shade well.

Flowers large, showy, somewhat trumpet-shaped, but broadly opened, purple, yellow, white, red, or of intermediate hues and mixtures, generally with 6-30 flowers on a spike, closely crowded and maturing from bottom up. Blooms from 60-120 days after corms are planted. Pollination by insects and birds.

A tender perennial. Plant corms 4 in. deep, 2-3 in. apart, in rows $2\frac{1}{2}$ -3 ft. apart, and cormlets about half as deep and far apart. Water thoroughly once each week during blooming period. Cut spikes, leaving 3 leaves to renew the corm. Dig corms in fall, and store away from frost.

Important garden and cut-flower plant. Attacked by thrips and aphids but controlled by nicotine sulfate. Also attacked by a blight, borers, a neck rot, and a scab so avoid planting infected stock or planting in infected soil.



Blue-eyed Grass



Freesia



Crocus

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Liliales. Family Iridaceae

Blue-eyed Grass *Sisyrinchium montanum*

S. angustifolium has stems bearing flowers. These reach a height of 2 ft., are stiff, pale, and covered with a gloss. Leaves vary from being longer than stem to half its length, and are to $\frac{1}{4}$ in. wide, flat, sword-shaped, rather stiff, and with fine marginal irregularities.

Found in fields and meadows, from Newfoundland to British Columbia south to Virginia, Nebraska, Colorado, and Utah, with closely related species extending range considerably. Some of species are difficult to separate from others.

Flowers to $\frac{1}{2}$ in. long, deep blue with some yellow, borne in small clusters, on short stems, at base of a spathe, which appears essentially as a continuation of stem that bears it and flowers. Fruits spherical, to $\frac{1}{4}$ in. high, brown, purplish, or white, and often held erect.

Names star grass, pigroot, blue-eyed grass, blue-eyed Mary, grassflower and others indicate that the plant has attracted attention widely and favorably. It never grows in sufficient abundance to be a severe pest and it rarely competes at all with important crops.

Men are interested in this plant because of its beauty and possibly because it is difficult to interpret the different species properly.

Freesia *Freesia refracta*

Height to 18 in. A weak plant, standing only partly erect, remotely branched, and with comparatively few leaves that are reduced, slender, about 3-10 in. long, to $\frac{1}{2}$ in. broad, flat, parallel-veined, and sheathing stem at base. Stems arise from an egg-shaped, bulb-like corm.

Native of South Africa in region of Cape of Good Hope, but grown extensively by florists the world over, being offered to trade mostly at Christmastime. In century and a half that plant has been manipulated by florists, it has changed considerably in form and color.

Flowers, 5-6 in a cluster, held in a horizontal row, at or near tip of stem, fragrant, pale yellow, funnel-shaped, with tubes to $1\frac{1}{2}$ in. long, tube being sharply restricted below middle. Sepals, 3, lower one being with a dark-yellow spot. Petals, 3. Stamens, 3, with long, white anthers.

Planted 6-8 in a flat, 6-in. pot, about 1 in. deep, in $\frac{1}{4}$ manure, $\frac{1}{4}$ sand, $\frac{1}{4}$ garden soil, in August, should yield flowers in 10-12 weeks if temperature is the ideal between 50-70°F., if there is moderate sunshine and enough moisture to keep the soil moist at all times. Corms may be kept dry during summer.

Grown easily even by amateurs who will follow rules and have suitable equipment and patience. Since flowers can be produced in from 6-7 months from seeding or in 10 weeks from setting bulbs, a generous plantation for home window box or garden can be built up quickly.

Crocus *Crocus* sp.

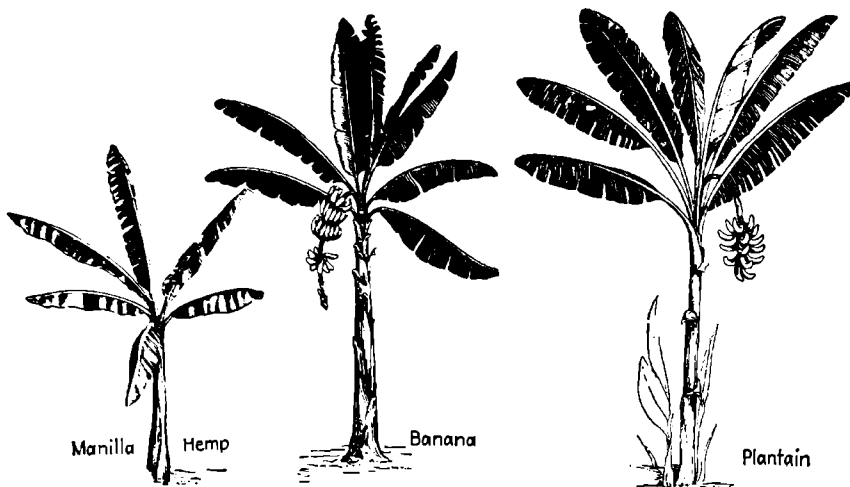
Height to 8-10 in. From flat-topped, rough-fiber-covered corm arise leaves. Leaves grass-like, dark-green, with a white stripe down middle, parallel-veined, enclosed in a papery sheath at first, and to 10 in. long. Roots, from the base of the corm; fibrous.

Native of Europe and Asia, mostly from Italy to southern Asia. Common species include fall-blooming *C. sativus*, or saffron crocus, and at least 4 spring-blooming species. Among these latter are yellow-flowered, *C. moesiacus* and *C. susianus*, cloth of gold crocus, and the blue, white, or yellow, *C. biflorus* and *C. vernus*.

In most species, flowers appear first thing in spring. Usually goblet-shaped, 3-5 in. long, with slender tubes, with 3 sepals, 3 petals, 3 stamens, and 3 parts to ovary. Reproduction most commonly effected by offshoots from corm, though seeds may be produced and used.

For indoor growing, plant 6-7 corms in a 4-in. pot or flat, in late summer or fall, in a mixture of equal parts sand, garden soil, and rotten manure at a temperature of 45°F. at first, in the dark, then after a few weeks raise temperature to 60° and then to 70°. Seeds produced at ground surface easily overlooked.

One of most popular and effective of early spring flowers, but to get best results, bed should be dug up at least once in 3 years and corms separated and replanted. Plants do best if there is an abundance of moisture at time of blooming. Corms set out outdoors in October should bloom early following spring.



PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Musales. Family Musaceae

Manilla Hemp, Abaca
Musa textilis

Height to 20 ft. General appearance almost identical with banana. Leaves often spotted, with the fiber found in the sheathing leaf bases that form the 20-ft. trunks. Like banana, plant is not a tree, nor is it a woody plant. Inner leaves more valuable. A cut stem weighs from 20-80 lb. Perennial.

Close relative to banana and to many ornamentals. Grows best in Philippines, especially on Luzon and to the south, where there is a warm, moist climate, a deep, rich, well-drained soil, and 60 in. or more of annual rainfall. Attempts to introduce abaca into American tropics have failed, partly because of diseases.

Fruits inedible, with seeds the size of BB shot and borne on drooping spikes. Reproduces largely by sucker shoots. Field is cleared and burned, suckers planted, and competitive weeds removed. Plants mature in about 3 years, when they should be cut. Young leaves give weak fiber; older leaves, harsh, brittle fiber.

Leaf bases contain 90% water. Requires 5 acres of plants to yield 1 ton of fiber. The shoots cut are replaced by developing suckers. Approximately 1 million acres of land in Philippines yield annually 150,000 tons of manilla fiber. Grades of manilla fiber include "current," "fair," "brown." Knotted abaca is hand-sorted and tied fiber.

One of most valuable Philippine exports. Knotted abaca is twisted into twines and then braided by hand or by simple machines in Japan. A piece 250 ft. long and $\frac{3}{4}$ in. wide brings, after all labor, only about 50 cents.

Banana
Musa paradisiaca sapientum

Height to 30 ft. or more. Not a tree or a woody plant, but a perennial herb. Trunk-like structure bears a crown of erect or arching paddle-shaped leaves, and arises from sucker or huge underground bud about size of a football. Suckers often produced in abundance at base of main stem but should be removed to increase vigor of bearing plants.

Native of India but grown extensively in tropics around the world. Dwarf Chinese banana, *M. cavendishii*, grown for ornament along coast of Gulf of Mexico and in southern California as well as in greenhouses of botanical gardens. First introduced into United States in 1804. First full cargo of 1,500 bunches in New York in 1830.

Commercial bananas do not produce seeds. Flowers appear in erect clusters that bend downward as they mature. Plant or erect stem bears fruit but once, usually from 10-12 months after shoot development or transplanting begins. Because of developing suckers, plant may bear several years if free from pests. Staminate flowers drop off.

Light frost will kill leaves and prevent fruit formation or development, but new suckers will arise and fruits may be borne the succeeding year. In a hothouse, plant may not bear fruit until shoot is 2-3 years old. Not economical to raise the plants under glass for their fruits.

Fruits are picked green and may be eaten raw. Vitamins B and C present. Banana flour is made by drying ripe bananas. Plant provides an abundance of cheap, highly nutritious food and is one of most important of all foods in the tropics.

Plantain
Musa paradisiaca

Height to 30 ft. Stem herbaceous but rigid. Leaves erect or ascending, brighter green than in bananas, to 9 ft. long and to 2 ft. broad, usually rounded at base, and with petiole to $1\frac{1}{2}$ ft. long. Underground swollen areas suggested for banana are also found in plantain. Known as "Adam's fig."

Native of India, but cultivated extensively in the tropics particularly in West Indies and Central America. This is the species of which banana is considered by some to be a subspecies. The subspecies has many varieties including the ladyfinger, the Dacca, the Chotda, the Lacatan, and the red banana.

Plantain has staminate flowers that are persistent while those of banana drop off. There are about a dozen yellow-white staminate flowers to a cluster and to 80 pistillate in a bunch. Fruit to 1 ft. long, yellowish-green when ripe, and with firm flesh.

No record of plantains ever having been reproduced by seeds by man. In spite of the fact that fruit is inedible when raw, it has superior nutritive values when cooked. Because of ease with which cooked plantain or plantain flour is digested, it is frequently recommended for use by invalids and children.

While a visitor to the tropics will always have the opportunity of eating plantain, he will probably have to develop an appetite for it but afterward the dish is likely to be a favorite. Baked plantain, yams, papayas, mangos, and plant-ripened pineapples are among the things remembered by those who visit tropics.



Ginger



Zebra Plant



Canna

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE

Order Marantales

Family Zingiberaceae

Ginger

Zingiber officinale

Height to over 3 ft. Reed-like. Leaves to 8 in. long, to $\frac{3}{4}$ in. wide, slender, without petioles, arising from a coarse, irregular, tuberous rhizome, with flower-bearing stem not unlike leaf-bearing stems. Both leaves and rhizomes strongly aromatic.

Native of tropical Asia, but widely cultivated throughout tropics of the world. Introduced into southern Florida and grown somewhat in greenhouses. This is not the wild ginger of the North (*Asarum*) or the flowering ginger (*Hedychium coronarium*) used so much in leis in the Hawaiian Islands.

Flowers borne on dense spikes, to 2 in. long, pale green with yellow margins, may be spotted with purple or yellow, lip being usually purple, and segments being about $\frac{3}{4}$ in. long. Fruit an oblong capsule that breaks open irregularly.

In Florida, ginger is grown on rich soil, in shade. Probably nothing in climate of southern Florida and southern California to interfere with commercial cultivation of ginger there. Rhizomes contain starch, an essential oil, gums, and oleoresin, the content varying with the variety.

Medicinal ginger comes from dried rhizome; ginger for flavoring, from the green root; candied ginger, from succulent, young roots. Candied roots are peeled and then preserved in a sirup. Leaves of ginger are supposed to roll upward; those of the garland flower, downward.

Family Marantaceae

Zebra Plant

Calathea zebrina

Height to 3 ft. Leaves spring from a short base bearing up to 20 leaves. Leaf blades to 2 ft. long and to 1 ft. broad, rich green above, marked in alternating yellow-green and dark olive-green bars, with underside gray-green when young and purple-red when mature. Petiole to 2 ft. long.

Native of Brazil but one of commonest of foliage potted plants grown in greenhouses. Requires more warmth than prevails in some homes and must be therefore kept in a warm greenhouse. Over 100 species known and about half of these are cultivated for some purpose.

Flowers in a spike that is almost globular. Flowers of *Calathea* larger than those of true *Marantia*. *Calathea* lacks zigzag stems and branching flower stalks of *Marantia*. However, these plants are known mostly from their foliage and are reproduced mostly by dividing underground parts.

Ideal temperatures for these plants is not below 65°F. at night and up to 90-95° in the day, with a high humidity at most times. They require a well-drained soil but a generous amount of moisture at all times. In greenhouses, they should be sprayed regularly.

Outdoors, where conditions are right, the plant grows and multiplies rapidly. It can be grown outdoors in some parts of Florida successfully but should be transplanted regularly to prosper.

Order Scitaminales

Family Cannaceae

Canna

Canna indica

Height to nearly 5 ft. Such related species as *C. edulis* may grow to 10 ft. high. Leaves green, about twice as long as wide, smooth throughout, with entire margins, and with bases clasping stem. Roots heavy, tuberous, branching, with many finer, spreading roots.

Native of tropical America, though thought by Linnaeus to be a native of Asia and Africa. About 50 species native of Western Hemisphere, some of which have become naturalized outside their normal range. Favors deep, loose, well-watered soil. When brought from West Indies in 1830, was grown for leaves only.

Flowers normally red or orange, with $1\frac{1}{4}$ in. petals, mostly borne in 2's, erect, relatively narrow, with lips orange spotted with red. Seeds will not normally germinate unless filed to let in water, may be soaked in warm water a day on back of stove before being sown. Hard seeds give name Indian shot.

Roots dug in autumn, stored in cellar with earth left clinging. May be started indoors in March after being divided so that each piece has one bud or eye. Potted plants rarely set out before May, should then be set 16-18 in. apart; are tender, subject to drought, frost, or too much water.

Most attractive of foliage plants. Purplish-leaved species, *C. edulis* and *C. warwickii*; the former bears edible tubers that yield Queensland arrowroot starch as well as being attractive foliage plant. *C. indica* is old-fashioned green canna, so common in old gardens and in lawn corners.



Fringed
Habenaria



Cattleya



Vanilla

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Orchidales. Order Orchidaceae

Large Purple-fringed Orchid
Habenaria fimbriata

Height to about 5 ft. Lower leaves oval, to slender lanceolate, becoming reduced above to mere bracts. Lower leaves to 10 in. long and to 3 in. wide. Stem ridged and clasped by bases of leaves. Roots branching from base of stem.

From Newfoundland to Ontario, south to North Carolina. A close kin to *H. psychodes* that is smaller and ranges over the *H. fimbriata* range and west to Minnesota and Tennessee. A score of *habenarias* in northeastern United States, 7 on Pacific Coast, and about 50 in all.

Flowers in spikes as shown, spikes being to 1 ft. long and to 2½ in. in thickness with flowers densely crowded. Lip of petals to about ½ in. long, magenta pink or white. Flowers fragrant, with a spur to 1½ in. long, spur being exceptionally slender.

Pollination by visits of moths and butterflies, on whose heads pear-shaped masses of pollen become glued when insects have sought nectar for their food. This orchid favors rich meadows or woodlands.

Of little economic importance, but a common popular orchid that should be left in its glory rather than picked for temporary admiration. The *habenarias* in general are called the rein orchids. The long-spurred rein orchid is often found in the South, floating with masses of water hyacinths.

Cattleya
Cattleya iranea

Structures known as "pseudo bulbs" lie between leaves and roots. In this species these are erect, club-shaped, to 1 ft. long, and bear 1 leaf that is to 8 in. long, relatively thick, broadly paddle-shaped and smooth. Roots in part visible and spongy, and of a heavily branching type.

Native of Colombia but is grown widely in greenhouses and outdoors in suitable climates as an ornamental. Some 50 species of *Cattleya*, this one sometimes being considered a variety of *C. labiata*, which species includes many of the important cultivated forms.

Flowers to 6 in. across, white, delicate rose or amethyst-blue in spots. Sepals much narrower than petals that are blunt and with crisped edges. Lip narrow, long, usually rose-colored. Throat yellow, and often streaked. Front lobe shorter than tube.

During spring, winter, and fall, where cattleyas are raised in greenhouses, night temperatures should be between 50-55°F., but at all times they should have as much fresh air as is possible. In hot weather, they should be watered in the evening with a delicate spray.

This is possibly the most popular group of commercial orchids available from florists. There are many varieties of the species and many related species, but this one is common for the amateur and for the professional orchid raiser.

Vanilla
Vanilla fragrans

Stem climbing, leafy, fleshy, tall, bearing many thick leaves to 8 in. long and to over 2 in. broad, with indistinct, parallel veins. Both leaves and stems somewhat fleshy. One closely related variety grown for ornament has variegated and striped leaves.

Native of Mexico and Central America, but grown to some extent in other parts of the tropics, with greenhouse varieties grown rather extensively outside the tropics as an ornament and as a curiosity.

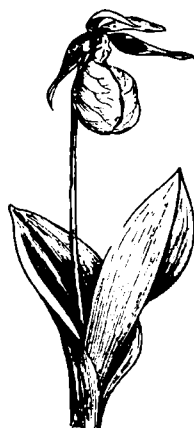
Flowers, 20 or more, in an open cluster, yellow-green, to 2½ in. or even more long, with lips narrow, trumpet-shaped, and shorter than other parts. Fruit a long, fleshy, bean-shaped capsule that opens little if any for shedding seeds.

Commercial propagation is effected by cuttings. Plants are trained on posts and flowers are artificially pollinated by man. Pods not aromatic until they are cured. Unripe fruits are picked, exposed to sunlight during morning, then "sweated" under blankets in afternoon, and put in airtight boxes for the night.

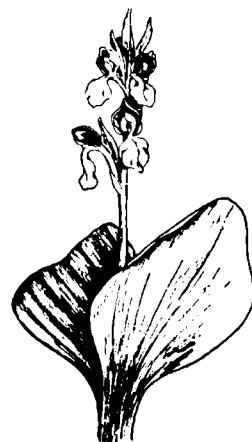
Spaniards found the Aztecs using vanilla to flavor chocolate. Flavor is due to a crystalline substance vanillin, caused by an enzyme working on a glucoside in the pods. A synthetic vanilla, made from eugenol, has been developed but there is still a strong demand for the natural product.



Showy Lady Slipper



Moccasin Flower



Showy Orchid

PHYLUM SPERMATOPHYTA. CLASS MONOCOTYLEDONEAE
Order Orchidales. Family Orchidaceae

Showy Lady's Slipper
Cypripedium reginae

Height to 2 ft. Stem rather densely covered with somewhat sticky hairs, stout, leafy clear to the top. Leaves to 7 in. long, to 4 in. wide, elliptic, acute at free end, with conspicuous, parallel veins. Roots coarsely fibrous.

From Newfoundland to Minnesota, south to Georgia. Found mostly in swamps and wet woodlands, often in considerable numbers. In the same general area are found other leafy-stemmed *Cypripediums* such as small yellow *parviflorum*; large yellow *parviflorum* v. *pubescens*, and small white *candidum*.

C. hirsutum has 1-3 flowers, each with a conspicuous white or pink-tinted lip, that appears inflated and is to 2 in. long. Sepals longer, and broader than the petals. This is easily one of the most beautiful of all wild flowers. Fruit a capsule. Seeds minute.

This species is often known as *C. reginae*, which name well describes dignity of the whole plant, while name *hirsutum* describes nature of leaves and stems. Hairs found there yield a fatty acid that is poisonous to many people, causing blisters and inflammation in 8-10 hours.

The beauty of this plant is such that it should be left where it is. If people generally knew that they might get something similar to ivy poisoning from it, they might leave it alone. It also grows in the same places where poison sumac grows.

Moccasin Flower
Cypripedium acaule

Leaves 2, lie almost flat on ground, to 8 in. long and to 3 in. wide, dark-green, with conspicuous, parallel veins. Roots fleshy, fibrous, and much-branched. Flower-bearing stem may reach a height of 15 in. and may bear a small, leaf-like bract on it.

Found from Newfoundland to Manitoba and Minnesota south to North Carolina and Tennessee. In Virginia, ranges to altitudes of 4,500 ft. It bears a number of common names such as Noah's ark, squirrel's shoes, camel's foot, nerveroot, old goose, Indian moccasin, and two lips.

Flower borne singly at top of a tall stalk or scape; conspicuous largely because of its inflated lip, which is 2 in. or more long, pink or sometimes white, and marked usually with dark lines. Sepals greenish-purple, spreading, to 2 in. long, with lateral ones united.

Favors sandy or gravelly woodlands, usually where soil is thin and likely to be slightly acid. Leaves may be found through most of year with flower or fruit body on scape that rises between them. Flowers appear in May and June.

This is State flower of Minnesota, and in New York State and some other states it is illegal to pick the flower on state-owned lands, or to transplant or injure the plant at any time when it is growing on such lands.

Showy Orchid
Orchis spectabilis

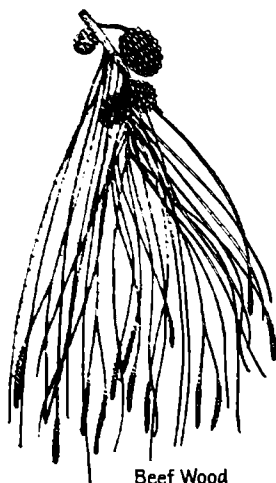
Flowering stems reach to a height of 1 ft., are angled, coarse, fleshy, and too easily broken. Leaves 2, borne close to the ground, often resting on it; to 8 in. long and to 4 in. wide, a beautiful, clear green, smooth, and clammy to the touch, parallel-veined. Roots coarsely fleshy, fibrous.

Found from New Brunswick to the Dakotas, south through Georgia, Kentucky, Missouri, and Nebraska. In Virginia, it is found at altitudes of to 4,000 ft. The plant is usually found in areas to which the plant-collecting botanist has no access.

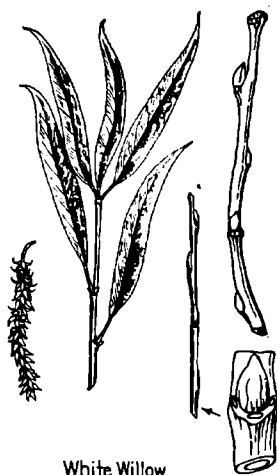
Flowers borne in a spike of 3-6 flowers. Flowers about 1 in. long, violet, purple, and white, with lip whitish, entire, and about as long as petals. A spur about $\frac{3}{4}$ in. long may be conspicuous. Fruit a conspicuously angled capsule, about 1 in. long.

This plant favors rich, wet woods and is often found at lower edges of slopes from steep hills, where soil is deep and water abundant at flowering time in May and June. Whole plant is much too attractive for its own prosperity in densely populated regions.

Probably no great economic importance to plant, but those who know it best wish it had the legal protection afforded many of its fellows.



Beef Wood



White Willow



Pussy Willow

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

In these plants, treated on pp. 149-342, there are two cotyledons or seed leaves in the seed, the leaves are commonly netted-veined, and the flower parts are in 4's, 5's, or multiples of these numbers.

Order Casuarinales Family Casuarinaceae

Beefwood, She-oak, Ironwood *Casuarina equisetifolia*

Tree to 150 ft. high, with pale green, round, drooping branches, with a generally erect, open appearance. Some species have 4-angled branches. Branchlets appear to be jointed like stems of *Equisetum* or horsetail, with sheath teeth at joints, 6-8, closely pressed to stem. No true leaves such as are usually found on trees.

About 25 species to be found in Australia, East Indies, and New Caledonia as natives. This species planted extensively as shade tree in parts of southern United States, common in Hawaii, Jamaica, Cuba, and similar areas. Since it grows well in brackish and acid soils, it is common along coasts.

Flowers either pistillate or staminate, the staminate appearing in small cylinders at ends of branches, and pistillate appearing as coarsely roughened balls or crude cones, $\frac{1}{2}$ in. in diameter, borne on loosely hanging stems. True fruit is a winged nutlet, borne inside cones.

Wood bright red, giving tree the name beefwood. Known as "oak" in Australia, and is valuable for many uses; hard and durable and burns quickly. Propagation normally by seeds or by making cuttings. Sometimes grown in greenhouses because of its unique form, but this is not a common practice.

In South, often planted in rows along roadways and sometimes along streets. Grown in Australia for its wood; along the shores of many tropical areas it serves as an anchorage to hold drifting sands.

Order Salicales Family Salicaceae

White Willow *Salix alba*

Tree to 80 ft. high, with short, thick trunk, with coarsely grooved bark. Branches yellow-brown. Branchlets greenish, and permanently silky. Leaves ashy-gray, and permanently silky on both sides, to nearly 5 in. long and to 1 in. wide. Related yellow willow, *S. vitellina*, has yellow branches and leaves that are silky when young but smooth when mature.

White willow is European. While it is grown in parts of America, it does not establish itself so well as does the related yellow willow that has become common throughout eastern North America. Both willows favor areas where there is an abundance of available water.

Flowers borne in catkins on short, lateral branchlets, the yellowish scales falling before fruits open to free fluffy seeds. Catkins from 1-3 in. long, not recurved, sometimes weak but not drooping. Some consider yellow willow a variety of white willow. Crosses freely with crack willow and with shining willow.

Wood soft, light brown, easily worked, takes a high polish, tough. Pollination by wind, the staminate and pistillate flowers being on different trees. Seed dissemination by wind, fluffy seeds being carried long distances. Staminate yellow willow is not common in America.

Tree used as an ornament, as an anchor for controlling stream cutting. Roots may penetrate and clog sewers. Twig trash sometimes troublesome. Some varieties are used in basketry; wood is used in making artificial limbs, charcoal, in wood-burning products, and, by scouts, in making fire by friction. It does not make a lasting fire.

Pussy Willow *Salix discolor*

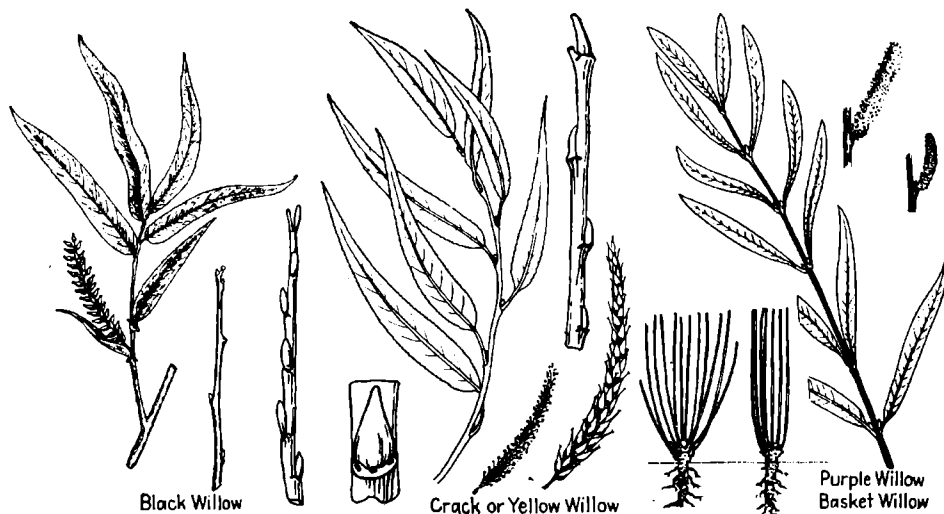
Shrub or small tree. Height to 25 ft. Trunk diameter to 8 in. Trunk usually short, with many ascending branches that form round crown. Twigs at first hairy, then smooth and stout; flexible, red-purple to dark-green. Leaves alternate, smooth, bright green above, smooth, gray beneath when mature, to about 5 in. long.

Found from Nova Scotia to Manitoba, south to Delaware and Missouri, being most common at edges of marshlands, along streams, sometimes on moist hillsides, but will grow in dry regions if transplanted when well-developed. Usually grows mixed with other willows and shrubs rather than as a pure stand.

Flowers appear in March, or earlier, on twigs of previous season's growth before leaves appear. Staminate and pistillate catkins on separate plants, catkins being densely flowered and with brown-tipped bracts; develop from the well-known "pussies." Long, shining hairs on flower scales. Fruits, fuzzy capsules.

Twigs may be cut in winter and forced to form "pussies" indoors. Since these have a commercial value with florists, the plant has some use other than as a soil anchor or as an ornamental. It may be easily reproduced by rooting slips in water and transplanting these to suitable ground. Wood weighs about 28 lb. per cu. ft.; soft and weak.

Commercial value lies in its attractiveness as an ornamental, and in use of early spring flower buds for indoor decoration. Frequently grotesque grafts are made to produce unique ornamental trees used in landscaping. This plant provides the commonest perch for popular pictures of birds singing in the early spring.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Salicales. Family Salicaceae

Black Willow *Salix nigra*

Tree to 120 ft. high, scrubby, densely branched, with slender twigs and rough, dark, deeply furrowed bark. Twigs with smooth, dark bark, appressed, 1-scaled buds, and narrow leaf scars. Leaves alternate, short-stalked, with tapering, curving tips, much longer than broad, to 4 in. or more long.

Common along streams and in wet places but may be found on gravels or sand where there is an abundance of light. Found to elevations of 2,000 ft. in New York State, and at sea level on sand barrens. Ranges from New Brunswick to Ontario and the Dakotas, south to Florida, Arizona, California, and Coastal Plain.

Staminate and pistillate flowers in tassels, 1-4 in. long, green, and appearing with leaves. Scales pale yellow and not dark-tipped. Nectary yellow, pale when dry as contrasted with a red to black nectary in peach-leaved willow. Fruits smooth capsules, about $\frac{1}{8}$ in. long, slender, in loose, drooping tassels, ripening in spring.

Wood light, diffuse-porous, with inconspicuous medullary rays, reddish-brown, 28 lb. per cu. ft., 22% as strong as white oak, has little fuel value. Pollination by wind and probably in part by insects. Seed dissemination by wind, which blows the down-covered seeds when they burst from the fruits. Reaches maturity at 50-70 years.

Greatest value is as a soil anchor. Fuel and charcoal are made from wood, and it is used in wood turning in making excelsior, bats, boxes, crates, boats, waterwheels, baskets, and wicker furniture. Tree is always too irregular in shape to have any timber value and wood is too weak for heavy construction purposes.

Crack or Yellow Willow *Salix fragilis*

Height to 80 ft. Diameter of trunk to 6 ft. Bark gray, thick, rough. Form tall, slender, profusely branched. Twigs angular, red, or yellow-brown. Bud 1-scaled, $\frac{1}{6}$ - $\frac{1}{4}$ in. long. Leaves alternate, smooth, both sides green, to 6 in. long and to 2 in. wide, with 10-17 fine teeth to the inch on the margin.

Common where there is an abundant supply of fresh water, being introduced into America from Europe, and well-established through eastern half of United States. Relatively few staminate trees in America but tree has hybridized freely with native species.

Stamens and pistils on separate tree. Staminate tassels 1-2 in. long. Pistillate tassels to 3 in. long, and slender. Pollination by wind, in April or May. Dry seed case $\frac{1}{8}$ in. long, on a short stalk, matures in early summer, opens to free fluffy seed into wind.

About Civil War time, this tree was sold freely and abundantly to American farmers. It will develop from a stake driven into ground or from cuttings thrust into or dropped on ground. Wood light in weight, salmon-red in color. Attacked freely by twig-cutting, leaf-eating, and wood-boring insects, and by bracket fungi.

Has been grown freely as an ornamental and as a stream anchor. Wood used in making small boats, in making charcoal, but is not useful as a firewood or in heavy construction. It warps badly in curing unless great care is taken. Recorded as being eaten by cottontail rabbit.

1. Purple Willow *Salix purpurea*

2. Green Willow *Salix amygdalina*

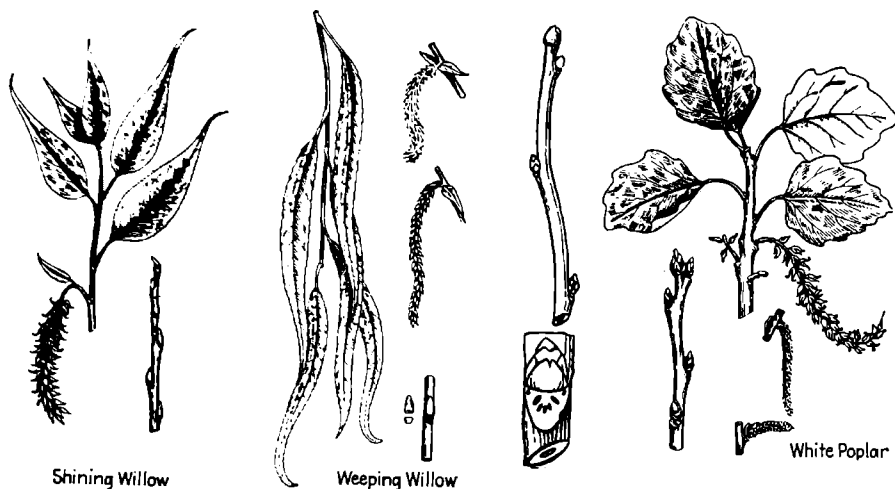
(1), shrub or small tree, with long, erect, uniformly diametered twigs. Leaves to 3 in. long, smooth, paler beneath, sometimes nearly opposite, and with short stalks, or none. (2), shrub or small tree to 30 ft. high, with bark in flakes. Twigs long and slender, but coarser than in (1). Leaves to 4 in. long, tapering pointed, light or blue-green beneath.

(1), native of Europe, but escaped and wild in North America, commonly planted for basketry in western New York. True basket willow, *S. viminalis*, is grown in Northwest but is useless in East and South. (2), popular in Europe and in America, particularly along the Mississippi where it withstands heavier soil and more water than does (1).

Staminate flowers of (1) have 2 stamens; of (2), 3 stamens. Bracts of the pistillate flowers dark at tip in (1) and light in (2). Leaf stalks of (1) without glands; of (2), with glands. Pollination is by wind or insects, and seeds are distributed by wind when fruits burst. Normal reproduction is by cuttings, which root freely.

Cuttings made 2 weeks after leaves fall, may be planted in spring, shoots being about 1 year old and 1 ft. long, or larger and older, for poorer ground. Usually spaced about 18-36 in. apart, are cultivated the first 2 critical years. Twigs are harvested in December or January, and yield may continue 25 years.

Harvested rods are peeled, dried, packed, and bundled. Profit of the yield of an acre may be around \$100 for the better years, although this implies that labor costs are low and that the land is not worth more than \$35 an acre for other purposes. Willow is grown locally or imported, but centers in America are near large cities.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Salicales. Family Salicaceae

Shining Willow
Salix lucida

Tree or shrub reaching a height of 25 ft., with a trunk diameter of 8 in. Trunk short, with ascending branches that form a broad, symmetrical crown. Bark thin, bitter, reddish-brown. Twigs shining yellow-brown, becoming darker. Buds about $\frac{1}{4}$ in. long smooth, pointed. Leaves hairy when young, but shining on both sides; when mature, to 6 in. long.

Found in wet grounds, along banks of streams and other waterways from Newfoundland to Manitoba, south to Pennsylvania, Kentucky, and Nebraska. Often grown as an ornamental where there is sufficient underground water to support it.

Staminate and pistillate flowers on separate plants; appear just before leaves unfurl. Staminate have 5 stamens, are in densely flowered catkins that are to $1\frac{1}{2}$ in. long. Pistillate in more slender catkins that are to 2 in. long. Fruit a smooth, stalked, straw-colored to pale brown or greenish capsule that frees fluffy seeds.

Wood of no commercial importance, and generally like other willow wood, weighing about 28 lb. to the cubic foot but rarely being suitable for timber. Glands on petioles, shining yellow-brown twigs, shining leaves, and 5 stamens to the flower are most distinguishing characters.

Of value only as an ornamental and as an anchor for soil in low areas where flood damage might result in the washing away of loose, rich soil. Commonly attacked by a variety of insects, some riddling the leaves during the worst seasons.

Weeping Willow
Salix babylonica

Tree to 40 ft. high, of rapid growth, with long, slender, purplish or olive-green twigs or young branches drooping from more or less erect trunk and limbs. Leaves to 6 in. long, narrowing at each end to slender points, at first silky but soon smooth, pale beneath. Winter buds slender, sharp-pointed, with only 1 scale showing.

Native of China but widely cultivated throughout world as an ornamental. Grown frequently in cemeteries as a symbol of sorrow, but a joy to behold. It grows as an escape along river banks and lake shores from Connecticut to the west and south.

Flowers appear in catkins, with leaves. Pistillate catkins to 1 in. long, green, slender and developing plump, stemless, fruit capsules that are to $\frac{1}{20}$ in. long, crowded, and burst to free fluffy, wind-borne seeds that often appear in great abundance. Not so hardy as the related *S. blanda*, or Wisconsin weeping willow.

May be propagated by cuttings. Escapes are commonly hybrids of the true weeping willow and some locally hardy species. It crosses freely with the crack willow, but the hybrid lacks the extreme beauty of the typical species. *S. blanda* has broader leaves, less pendulous twigs, longer petioles on the leaves, and longer stalks on the fruits.

Common ornamental willow of cemeteries. Frequently described in poetry of a sorrowful or morbid sort.

White Poplar
Populus alba

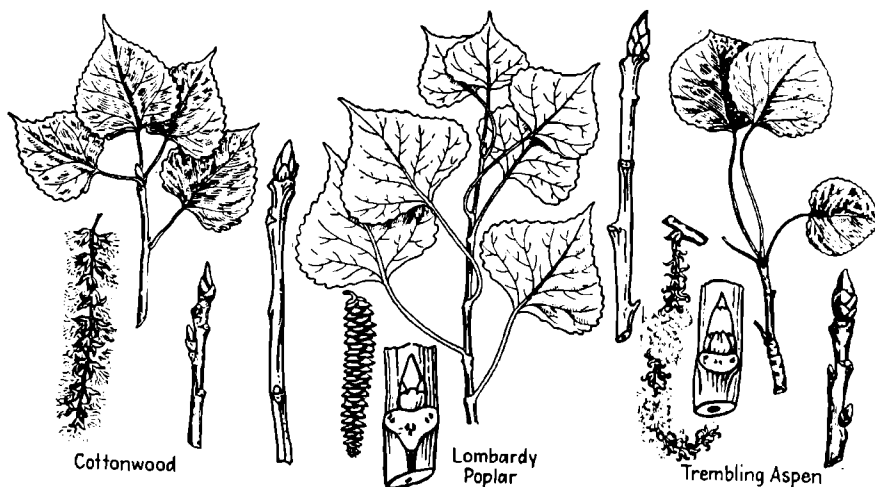
Tree to 95 ft. high. Trunk to 4 ft. in diameter. Twigs slender to stout, usually felty-white, with a wool-like down. Buds 2-ranked, to $\frac{1}{4}$ in. long, with stipule scars showing. Numerous short spurs. Leaves dark-green above, felty-white beneath, coarsely toothed, long-petioled, alternate.

Native of Europe and Asia but extensively grown as an ornamental in America and frequently becomes established as an escape. Closely related to gray poplar, *P. canescens*, and the Chinese white poplar, *P. tomentosa*, the latter having most "restless" leaves and making a sound like falling rain.

Staminate flowers borne in stalkless catkins 2 in. long or less, with 6-10 stamens per flower. Pistillate flowers borne in longer catkins, with stigmas slender and lobed. Fruit a thin, slender, 2-valved, short-stalked capsule that opens in summer freeing fluffy seeds into the wind.

Wood soft, weak, reddish-yellow, with nearly white sapwood, hard to split, weighs 38 lb. per cu. ft. Tree frequently spreads by shoots that arise from shallow roots. Easily propagated by cuttings that may be rooted in moist earth or in water. A poplar borer may cause severe injury.

Used essentially as an ornamental shade tree. Wood is poor as fuel but is made into cheap packing cases and flooring and finds some use as rollers that must be light and must not split easily. The Chinese white poplar does not propagate easily by cuttings. It is grown frequently in Chinese temple gardens.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Salicales. Family Salicaceae

Cottonwood
Populus deltoides

Tree to over 100 ft. high, with a trunk diameter to 6 ft. or more. Trunk tapers, sometimes straight and unbranched for a considerable distance above ground. Old bark gray and thick; young, thin, greenish-yellow. Twigs with large buds that are resinous and glossy. Leaves to 7 in. long, with petioles flattened near blade.

From Quebec to Rocky Mountains, south to Florida and Tennessee, but widely planted as a street tree in real-estate developments and used as anchors along waterways. Several varieties or races are recognized by botanists. Favors rich, moist soils, borders of lakes, and partially swampy areas.

Flowers appear in March or April, before leaves, with staminate and pistillate flowers in catkins, on different trees. Staminate catkins densely flowered, to 4 in. long. Pistillate catkins sparsely flowered, to 3½ in. long. Fruit a dark green, 3-4-valved capsule, in catkin, sometimes 1 ft. long.

Wood weighs 24 lb. per cu. ft., diffuse-porous, with pores just visible to naked eye, and indistinct medullary rays. Heartwood dark-brown; sapwood, white. Wood soft, warps badly, hard to split. Staminate trees used mostly for street purposes since they do not yield the annoying fluffy seeds. They do clog sewers with roots, however.

Grown as an ornamental in suitable areas; known to grow 5 ft. in a year and 40 ft. in 10 years. Cuttings placed in wet ground will grow rapidly with little care. Wood has some value as pulpwood and is used extensively in making cheap packing boxes, crates, berry baskets, and rubs. Tree outlawed in some cities.

Lombardy Poplar
Populus nigra var. *italica*

Tree to 150 ft. high, with trunk to 6 ft. or more in diameter, and with all branches and twigs extending almost straight up, producing a tall, slender, irregularly cylindrical tree. Suckers arise in great numbers from base. Leaves, triangular blades, shining, dark-green, and with petioles flattened near blade.

Originated from a staminate sport of typical *Populus nigra* on plains of Lombardy about 1700 and has since spread widely over world as an ornamental. So common is it in areas originally settled by Mormons that it has been called "Mormon tree," since it is characteristic of many of their older settlements in Utah and Rocky Mountain area.

Known only in staminate form although black poplar from which it was developed has both staminate and pistillate flowers. It cannot therefore be reproduced by seeds but depends on suckers for spreading in limited areas and on cuttings for spreading elsewhere. Many trees are reported to have developed from whips.

A rapidly growing tree. Probably true black poplar frequently hybridizes with this. Many forms with minor differences that have been developed so that trees may be found in one form or another in widely different types of climate. Some are so hardy that they can survive severe winter weather.

Essentially an ornamental tree grown as windbreak to shelter farm buildings but also as street tree that occupies little space at base and reaches a great height. Figures prominently in concept of beautiful landscapes of Italy and southern coasts of Europe.

Trembling Aspen
Populus tremuloides

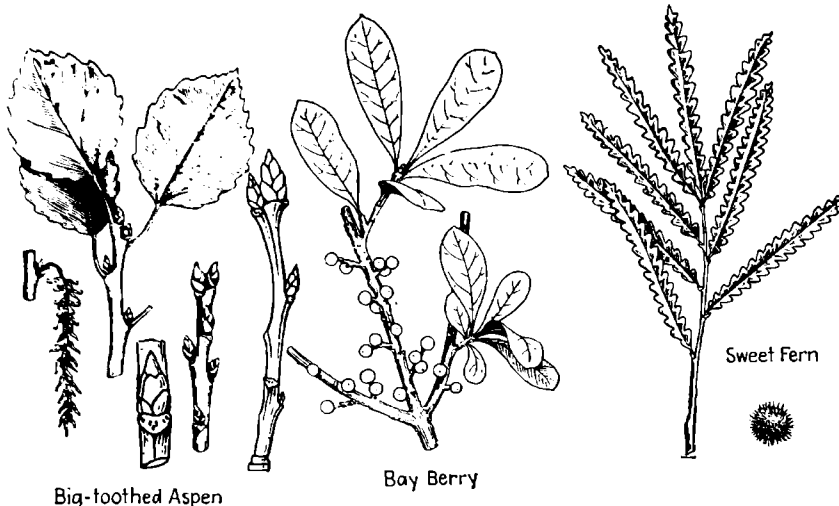
Tree to 80 ft. high, with a trunk to 20 in. through. Crown high, narrow, round-topped. Branches ascending, brittle. Bark on old part, thick, black, deeply fissured; on young, yellow-green to white, with dark blotches under branches. Twigs slender, reddish, shining, with white pith. Leaves to 2 in. long, thin, dark above and light beneath. Roots shallow.

From Newfoundland to Alaska, south to Pennsylvania, Kentucky, Mexico, and California, with probably widest range of any native North American tree. Grows on variety of soils, preferably where dry, does not survive in swamps. Abundant in cutover or burned-over areas mixed with fire cherry and fireweed.

Flowers appear in April, with pistillate and staminate on different trees. Staminate catkins drooping, to 2½ in. long, each flower with 6-12 stamens. Pistillate catkins when mature may be 4 in. long, drooping, with few flowers. Fruit a 2-valved, oblong cylinder, light green, drooping, bursting to free brown seeds with white, fluffy hairs.

Wood weighs 25 lb. per cu. ft., fine, light brown to white, diffuse-porous, with fine, indistinct medullary rays, not strong or durable. Distinguished from big-toothed aspen by sharper buds free from flour-like crust, and by lighter bark of younger branches.

Wood used in making packing cases, lard pails, buckets, wooden dishes, boxes. Considered weed tree, but with high demand for wood it may find a place as a rapidly growing pulp and cheap wood producer that thrives on a variety of soils under varying conditions. Eaten by ruffed grouse, deer, beaver, mountain sheep, and domestic cattle.



Big-toothed Aspen

Bay Berry

Sweet Fern

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Salicales Family Salicaceae

Big-toothed Aspen *Populus grandidentata*

Tree to 70 ft. high, with a trunk diameter up to 2 ft. Crown irregular, with branches usually more horizontal than those of trembling aspen, and with bark of young branches more yellowish. Twigs reddish-yellow, often crusty or pale woolly. Leaves to 4 in. long, dark-green above, lighter beneath, rather coarse.

Found from Nova Scotia to Ontario and Minnesota, south to North Carolina and Iowa but planted elsewhere as a quick-growing ornamental shade tree. Does best on rich, moist, or dry, gravelly soils, or on abandoned lands where it may form rather pure stands; essentially a forest tree.

Staminate and pistillate flowers on different trees; the staminate, in catkins to 4 in. long, and the pistillate, in catkins that at maturity reach a length of 5 in. Fruit 2-valved, about $\frac{1}{4}$ in. long, bursting and freeing brown seeds with coats of white, fluffy hairs.

Wood weighs 29 lb. per cu. ft., is soft, 30% as strong as white oak, weak; compact, diffuse-porous, light brown. Bark frequently badly infested with oyster-shell scale that may kill or weaken trees. Frequently associated with shadbush, birch, bird cherry, and scrub oak. Pollination and seed dissemination by wind.

Valuable as a soil anchor and as a species that will quickly cover lumbered-over areas and then give way to more valuable species. Thrives on burned-over areas. Wood used in making boxes and weak crates much as is wood of trembling aspen, though it is a little heavier than that species. A useful pulpwood species.

Bayberry, Wax Myrtle *Myrica cerifera*

Tree or shrub to 40 ft. high, but usually a low, sprawling shrub, forming a dense, stiff, thickset-like area. Leaves narrow and acute, to $\frac{3}{8}$ in. wide as contrasted with obtuse leaves of *M. carolinensis*, whose leaves may be $1\frac{3}{8}$ in. wide, and with entire margins. *M. carolinensis* is true bayberry. Leaves fragrant.

M. cerifera native of swamps and wet woodlands from New Jersey to Florida and the West Indies, west to Arkansas and Texas. *M. carolinensis* is native of moist, sandy soils from Nova Scotia to Florida, west to Lake Erie and Louisiana. Commonly sold by nurseries as *M. cerifera*. In New England, the common species is *M. carolinensis*.

Flowers appear in catkins before or with the leaves, those bearing stamens being cylindrical, and those bearing pistils more or less globular. Fruits of *M. cerifera*, under $\frac{1}{2}$ in. in diameter; of *M. carolinensis*, over $\frac{1}{2}$ in. in diameter. Fruits of both, when mature, covered with a pale blue, aromatic wax.

Wood of *M. cerifera* weighs 35 lb. per cu. ft., is light brown, but has little commercial value. Wax from fruits of both species is removed sometimes by boiling and floating off melted wax, which is then made into candles that burn with a most pleasing fragrance.

In addition to yielding wax used in making candles, these plants are most popular as ornamentals, since the attractive pale blue berries appear in great clumps that persist through winter. They are for sale in florist shops for use as interior decorations in winter but are at their best in the native setting.

Sweet Fern *Myrica peregrina*

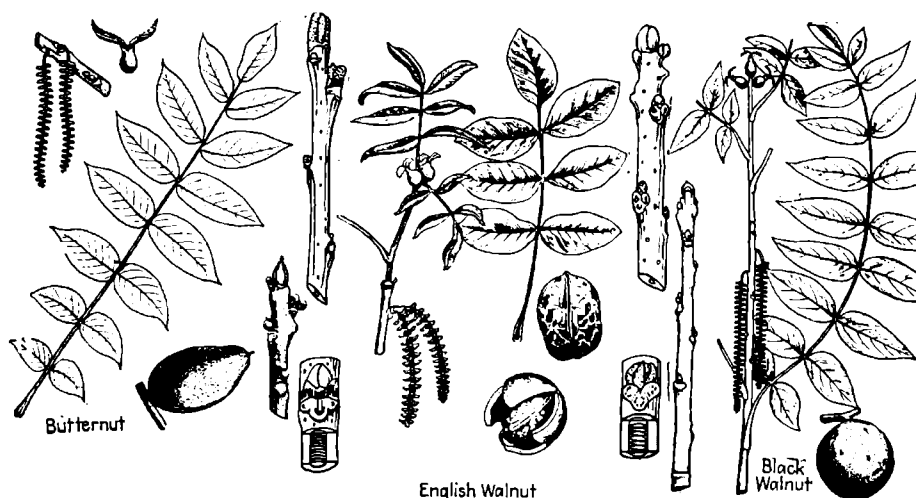
Shrub to 3 ft. high, erect, with spreading, profusely branched top. Leaves slender, with rounded lobes making them resemble some ferns, aromatic, with a prominent mid-rib persisting on the plant for some time after they have ceased to function, to 6 in. long and to $\frac{1}{2}$ in. wide but usually smaller.

Common on poor soils from New Brunswick and Nova Scotia to Saskatchewan, south to North Carolina and Indiana. In Virginia, found to an elevation of 2,000 ft. Over much of its territory is considered a highland plant. Because of its ability to thrive on poor, dry soils, it finds some favor as an ornamental.

Staminate and pistillate flowers in separate catkins, with both kinds, or only one, on given plant. Staminate catkins clustered at ends of branches, usually under 1 in. long, cylindrical. Pistillate catkins globular, bur-like when mature, borne back from tips. Fruit a light brown, shining, somewhat oval nut.

Serves as a good soil anchor and as an excellent shelter for small game, since it provides a dense cover above but adequate open space beneath. Little if any food value for wild animals. Considered by some farmers as an index of poor soil, since it will grow where ordinary farm crops will not. An interesting gall is formed around fruit.

In Revolutionary War times, used in making tea. Plant may be propagated by sowing seeds after they have reached maturity, or by layering, though this species is not so commonly cultivated as are other species of the genus. Leaves are crushed, dried, and used in pillows because of their fragrance.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Juglandales. Family Juglandaceae

Butternut, White Walnut
Juglans cinerea

Tree to 100 ft. high, with a trunk diameter to 4 ft. Trunk usually relatively short, and often crooked. Crown broad, round-topped, rather open. Twigs coarse, with pith in diaphragms. Terminal bud twice as long as wide. Bark coarse, with long grooves. Leaves to 30 in. long, with 11-17 leaflets, sticky.

From New Brunswick to Quebec, south to Georgia, west to Arkansas and Minnesota. Grows in rich, moist, deep soil, usually along fence rows, at edges of woods, or in abandoned corners. Commonly found at higher elevations than black walnut; survives sour soil conditions better than most nuts. Never found in pure stands.

Stamens and pistils in separate flowers on same plant, former being in catkins near ends of branches, catkins being to 5 in. long. Pistillate flowers in spikes of 6-8 flowers. Pollination by wind. Nuts 2 in. long, twice as long as thick, mature first year, germinating following spring if buried about 2 in.

Rarely live over 75 years, being attacked by fungi that sometimes take 20 years to cause death. Fruits weigh 16 to the pound, ordinarily germinate about 75%, and should be husked before being stored, should be planted permanently rather than transplanted in early spring; seedlings should be 10-18 in. high at end of first year.

Wood, known as "white walnut," weighs 25 lb. per cu. ft., is soft, 30% as strong as white oak, light brown, diffuse-porous, coarse-grained; used in furniture and interior finishings. Sap sweet; added to maple sap, makes sugar. Young fruits pickled in vinegar, sugar, and spice as "pickled oil nuts." Roots used medicinally. Dye from husks and bark used until 1860. Nut meats common in candy and ice cream.

English Walnut
Juglans regia

Tree to 70 ft. high, with a relatively short, straight trunk. Bark light brown or gray, roughened. Twigs coarse, with diaphragms in the pith. Leaves compounded of 5-15 leaflets, each 2-5 in. long, bright green and almost smooth, not easily confused with the other members of the genus.

Cosmopolitan. Cultivated in America mostly in California and Oregon but grows successfully in the East from Pennsylvania to Georgia. Trees in the more severe climates may survive but do not bear well, partly because of inability to mature flower-bearing parts. Large plantations are maintained in Europe, China, and California.

Staminate and pistillate flowers in separated parts on same tree. Pistillate flowers borne at end of a year's growth. Nuts enclosed in relatively thin husks, and have thin shells. Seedlings usually transplanted at 2 years, the taproot being cut. Many seedlings are budded, or top grafting is practiced.

Wood is a valuable furniture wood, known as French, Turkish, Italian, or Circassian walnut. Fruit known in commerce as English or Persian walnut. Wood durable, lighter in weight and in color than black walnut, and important as a timber tree in India where it reaches a great size. European nuts collected largely from woodlands.

Nuts have high food value. Hot-pressed oil from nuts used in artists' paints, printing ink, and soap. Cold-pressed oil used as human food, oil cake, as stock food. America formerly dependent largely on foreign countries for supply. In 25 years after 1911, importations dropped from 37 to 5 million pounds, caused not by decreased consumption but by increased local production.

Black Walnut
Juglans nigra

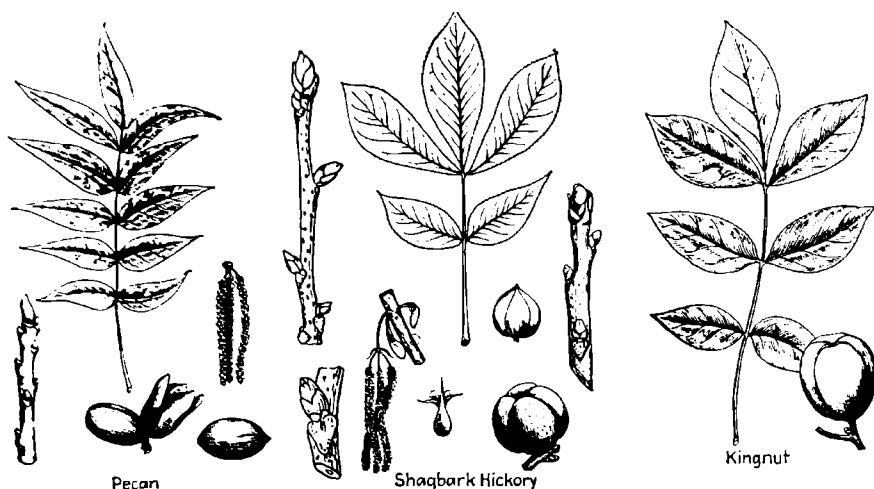
Tree to 150 ft. tall, with a trunk diameter to 8 ft. Trunk usually straight, clean, unbranched below, and with high, rounded crown. Bark dark, roughened, and broken into squarish units. Terminal bud about as wide as long. Twigs coarse, and with pith in diaphragms. Roots deep. Leaves with 15-23 leaflets downy beneath.

Found in rich lowlands and river bottoms where there is good sun and about 150 growing days in a season with an average temperature of 62°F. Best in slightly alkaline soils. From Massachusetts to Florida, west to Minnesota and Texas, generally in lower, warmer areas than butternut, often in relatively pure stands or small groups.

Stamens and pistils in separate flowers, on same plant appearing before leaves; staminate, in unbranched catkins; pistillate, in 2-5-flowered spikes. Nuts weigh 34 to the pound, with 78-80% germination, often delayed by several years; should be planted 1½ in. deep, 3-6 in. apart. Seedling 3-36 in., first year. Matures at 150 years; lives 250 years.

Wood heavy, 38 lb. per cu. ft., strong, rich, durable, not easily split. Tree relatively free from insect and fungus enemies but has a tent caterpillar and a red butt rot. Relatively fast-growing tree whose nuts are favored by squirrels, whose wood is more valuable than most of its associates, and whose bark yields a dye.

Nuts sell for from \$1-4 a bushel or nut meats at 75 cents a pound for use in candy and cookies. Wood so valuable it is used largely in making veneers, fine furniture, and gun stocks. Tomatoes and some other crops do not thrive near black walnuts. Can be cultivated with profit in upper Ohio Valley region, Missouri, and southern Iowa. Nut meats common in candy.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Juglandales. Family Juglandaceae

Pecan
Carya illinoensis

Tree to 170 ft. high, with straight, clean trunk. Roots deep. Bark smoother than in most hickories. Twigs coarse, with broad leaf scars. Leaves compound, of 9-17 leaflets, each tapering gradually to a slender point, minutely downy at first but with maturity becoming smooth.

Does best in rich, low bottom lands such as river bottoms. Ranges from Indiana to Georgia, west to Texas and Kansas. Commercial raising of pecans limited to South because tree must have 150 successive warm growing days if nuts are to ripen and tree to survive.

Pistillate flowers that produce fruits are formed in buds that are not developed until 12 weeks of a growing season have elapsed. Because of this, trees may grow in North, but no nuts will be formed year following a short season. Pollination by wind. Nuts thin-husked and thin-shelled, planted 2 in. deep, 4 in. apart.

Wood hard, durable, 45 lb. per cu. ft., light brown. Plant winterkills freely in northern part of range. Seedlings and grafts may be bought for starting a plantation. Seedlings for transplanting should be reset every 2-3 years to develop proper mass of roots, since this leads to an earlier fruiting habit. Fruit ripens in September.

Nuts of greatest value. Trees may begin to yield 3-4 years after being set out. Pecan nuts have a 70% fat content, which is higher than that of any other vegetable product. Nuts bring from 5-15 million dollars a year to United States farmers and support considerable labor in harvesting and preparing nuts for market.

Shagbark Hickory, Shellbark Hickory
Carya ovata

Tree to 120 ft. high, with trunk diameter to 4 ft. Bark gray, stripping off in long, loose, irregular pieces lengthwise of trunk. Form cylindrical. Roots deep. Twigs coarse, with large, loose-scaled, hairy terminal buds. Leaves alternate, compounded of 5-7 leaflets, of which basal pair is smallest. Leaves to 14 in. long. Leaflets stalkless.

On hillsides and in mixed forests, where soil may be rocky but is well-drained. From St. Lawrence River to Florida, west to Texas and Minnesota, except along southeastern coast. Requires long, warm summer to mature fruits and wood to bear fruits next year. At least 15 varieties are recognized.

Staminate flowers at base of season's shoot; pistillate flowers, at tip. Pollination by wind. Nuts mature in fall, and are enclosed in a thick husk, which splits to free delicious, hard-shelled nuts weighing about 90 to pound, and germinating from 50-75%. May live to 300 years but matures much earlier.

Wood exceptionally hard, weighs to 52 lb. per cu. ft., is hard, tough, 125% as strong as white oak, flexible, highly resistant to blows; one of strongest woods and one of best firewoods. Wood ring-porous, with summer wood pores, large, evenly distributed, not in groups or lines. Leaves may bear a mildew. Twigs attacked by a witches'-broom disease.

Wood used in making wheel spokes and axles, tool handles, baseball bats, baskets, golf clubs. Nuts have commercial value as food though not so high as walnuts. Nut meats yield excellent salad oil. Nuts favored by squirrels. Sap yields a sweet gum. Bark, mixed with glucose, tastes like maple sugar. Good lumber tree. Eaten by rabbits and deer.

King Nut, Big Shellbark
Carya laciniosa

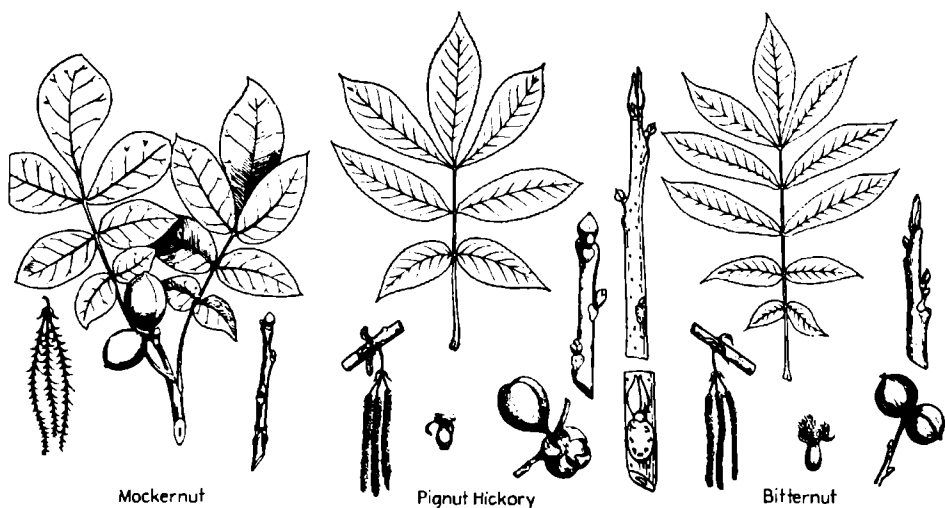
Tree to over 100 ft. high, with a trunk less robust than that of shellbark. In forests, trunk is long, clean, and slowly tapering. Bark less shaggy than that of shellbark. Twigs stout, usually slightly velvety. Buds larger than those of shellbark, with outer scales less keeled and more hairy. Leaves to 22 in. long, of 7-9 leaflets, dark-green above.

Found in rich, wet soils, often in flood lands or in lowlands not commonly the habitat of the shellbark. If found on hillsides, is in area of rich soil. Ranges central New York and Pennsylvania, west to Iowa and Nebraska, south to Tennessee and Arkansas. Rare in mountainous regions of its general range.

Flowers, in general, like those of shellbark, with staminate on wood near base of year's growth and pistillate, near tip of year's wood. Fruit to 2 in. long, globular, with thick husk that splits completely into 4 parts exposing nut that is white, oblong, slightly flattened, strongly pointed at each end, thick-walled, with sweet, light-brown meat.

Wood 50 lb. per cu. ft., very dark, 116% as strong as white oak. Propagated almost wholly by planting nuts, since seedlings do not transplant successfully because of long taproot. Should be planted extensively in suitable ground because of valuable timber and nuts. Will grow in areas too wet for black walnut, while shagbark will grow in soils too poor for black walnut.

Economic importance of the species centers around the lumber and nuts. Distinguish this plant from shagbark by the 7-9, rather than 5-7 leaflets, more downy underleaf surfaces, and dull white or yellow, strongly pointed nuts. Wood uses similar to those of the shagbark.



Mockernut

Pignut Hickory

Bitternut

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Juglandales. Family Juglandaceae

Mockernut

Carya tomentosa

Tree to 90 ft. high, but normally between 50-75 ft., with trunk diameter up to 3 ft. Crown oblong to round-topped. Trunk often swollen at base. Bark light gray, to $\frac{3}{4}$ in. thick, not shaggy nor smooth, but roughened by irregular furrows separating close, rounded ridges. Leaves to 12 in. long, of 7-9 leaflets, with fuzz that rubs off easily.

Found in rich, moist woodlands where there is abundance of sunshine and water, so usually in fertile valleys at base of slopes facing south. From Massachusetts and Ontario south to Florida, west to Texas and Nebraska, often making up an important part of a mixed hardwood forest. Grows at elevations of 3,500 ft. in Virginia.

Flowers appear when leaves are half-developed. Staminate flowers in 4-5-in. catkins, borne in 3's on a common stalk. Pistillate flowers borne in 2-5-flowered, pale, hairy spikes. Fruits globular, to $2\frac{1}{2}$ in. long with thick, hard husk that splits to middle or base. Nut brownish, 4-ridged towards apex, very thick-shelled, sweet.

Wood 51 lb. per cu. ft., 115% as strong as white oak, like that of shellbark but has wider, white sapwood that gives tree scientific name *alba*. Heartwood is dark-brown. Propagated almost wholly by seeds because of deep taproot that is usually injured when seedlings are transplanted. Nuts should be planted about 2 in. deep.

Wood is about the best of hickories for lumber and for fuel so tree should be encouraged where this is possible. Kernel of nut is too small to be considered of economic importance, and leaves form a trash that affects value as a street tree.

Pignut, Broom Hickory

Carya glabra

Tree to 90 ft. high. Trunk diameter to 4 ft.; usually slender, tapering, clean, long. Crown narrow, usually high, with lower branches often drooping. Twigs slender, smooth, yellow-green to red-brown. Buds oval, blunt-pointed, shedding outer scales in winter. Leaves to 12 in. long, of 5-7 leaflets, smooth, dark above.

Found on dry ridges and hillsides, though sometimes found in wet lowlands. From Maine to Ontario and Minnesota, south to Florida, Nebraska, and Texas. This is the hickory of the hilltops within its range. It does well in mixed forests with other broad-leaved trees.

Flowers appear when leaves are half-developed. Staminate flowers in catkins, about 3-5 in. long, in 3's on a common stalk. Pistillate flowers in 2-5-flowered spikes on new growth. Fruit to 2 in. long, pear-shaped or oval, reddish-brown, with a thin husk, a thick, bony shell, and a meat that at first tastes sweet but becomes bitter.

Wood 51 lb. per cu. ft., tough, dark-brown, 125% as strong as white oak. Tree most easily distinguished in winter by slender, smooth twigs, with small, reddish-brown, oval buds, whose outer pair of scales is smooth or dotted with glands, and which usually fall off before spring. Needs much sunlight to do well.

Of value primarily as a timber and firewood tree, for which its usefulness compares favorably with most other hickories. Nuts inferior to those of other hickories for food, but they are frequently sold mixed with other species and reputation for bitterness is probably exaggerated.

Bitternut

Carya cordiformis

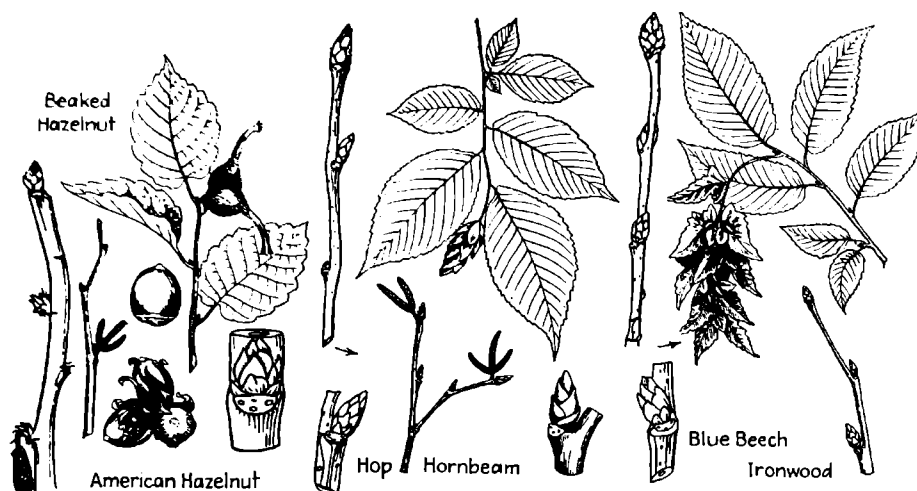
Tree to 100 ft. high. Trunk to 3 ft. in diameter, long, clean, with little taper. Crown round-topped, usually broadest at or near the top. Side branches ascending, or with drooping branchlets. Bark gray, thin, close. Twigs slender, smooth, with distinctly yellowish buds. Leaves to 10 in. long, of 7-11 leaflets, yellow-green above.

Found in low, wet, fertile areas along fence rows and at borders of marshes, woodlands. Does well on ridges in southern part of range but in north does better in valleys. From Quebec to Minnesota, south to Florida, Nebraska, and Texas. Does not occur in pure stands and is usually scattered over an area.

Flowers appear when leaves are about half-developed. Staminate flowers green, in 4-in. catkins, clustered in 3's on a common stem. Pistillate flowers in spikes, on new growth, and about $\frac{3}{2}$ in. long. Fruit to $1\frac{1}{2}$ in. long, with thin husk enclosing a thin-shelled nut, that is smooth, short-pointed, and at least as broad as long, with bitter meat.

Wood like that of other hickories, but weaker, more brittle, 47 lb. per cu. ft., 115% as strong as white oak, with less fuel value because of large amount of ash left, but this does not mean that it is an inferior fuel wood as contrasted with most trees commonly associated with it. May be best in woodlot. Does not do so well in shaded areas.

Should be developed as ideal fuel wood in areas where other hickories will not thrive. Unlike other hickories, endures transplanting well and so young seedlings may be placed where they will do best after being started in easily established seedbeds. Grows more rapidly than the other hickories and will therefore give a quicker return.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Fagales. Family Betulaceae

Hazelnut, Filbert *Corylus* sp.

Beaked hazel, *C. rostrata* (illustrated), shrub growing to height of 8 ft., with wings that are not bristly as in American hazel, *C. americana*. Filbert of commerce, *C. avellana*, tree to 15 ft. high, with a number of important varieties such as Barcelona, DuChilly, Alpha, Daviana, and Clackamas. Twig characteristics next to fruits in importance in identification.

Beaked hazel ranges from Nova Scotia to British Columbia, south to Georgia, Kansas, and Oregon; American hazel, from Maine to Saskatchewan, south to Florida and Kansas. Commercial filberts raised mostly in Washington and Oregon as they winterkill at 0°F. and fruit buds are injured below 12°F. A related tree, *C. colurna*, reaches height of 70 ft.

Staminate flowers in long, pendulous, yellow catkins appearing before the leaves. Pistillate flowers in short, red-tipped clusters, open for about 4-6 weeks. Pollination by wind. In orchards, Barcelona is commonly pollinated by white Avellana, Daviana, or DuChilly. Fruits mature in late summer or fall and average about ½ in. high.

Wood of little value, but trees and shrubs are used in landscape work. Filberts from hybrids of Eurasian species do best on average bottom lands and do not do well on poor soils. Plants easily pruned, grafted, and improved in production. Hazel stems were believed by some to be ideal as "divining rods" for locating water until value was disproved.

Commercial filberts may be made to yield 3,000 lb. of nuts per acre, though a normal yield is about 1,000 lb. Production costs are under 14 cents per lb. Oregon has produced as high as 2,320 tons a year but most nuts used in America are imported from Europe. Wood of *C. avellana* is an important hardwood.

Hop Hornbeam, Ironwood *Ostrya virginiana*

Tree to height of 60 ft., with trunk diameter to 2 ft. Crown open, high, broad, formed by widely spreading branches. Bark gray-brown, with loose scales peeling free at ends. Twigs slender, zigzag, with sharp-pointed buds covered by 8 visible, 2-ranked scales. Leaves to 5 in. long, yellow-green above and paler green below, alternate.

On dry, gravelly slopes, but sometimes in moist lowlands. Usually, in shade and where it is cool. Never in pure stands. From Cape Breton Island to Florida, west to Minnesota and Texas. 4 species, 2 of which are in United States, 1 being found only in Grand Canyon of the Colorado.

Flowers appear with the leaves; staminate, in loose catkins, about 2 in. long; and pistillate, in short, erect catkins, each in a bladder-like bract. Staminate catkins begin to appear the summer before they mature. Fruit a small, flat nutlet, in a bladder, making a hop-like arrangement, and shed during the winter, being blown along the snow.

Wood one of hardest, toughest, strongest known, but rarely abundant; weighs 51 lb. per cu. ft., diffuse-porous, with distinct medullary rays, light brown to white; is considered 30% stronger than white oak. In autumn, leaves turn yellow. Tree usually found mixed with other hardwoods as undergrowth for maple, oak, and chestnut.

Used in making tool handles, spokes, axles, and similar wooden equipment. Considered by foresters to be a weed tree, and for decades was destroyed to make place for species that were of more value as lumber. Wood excellent for fires, making a hot fire with coals that persist. Tree attractive, and frequently used as an ornamental.

Blue Beech, Musclewood *Carpinus caroliniana*

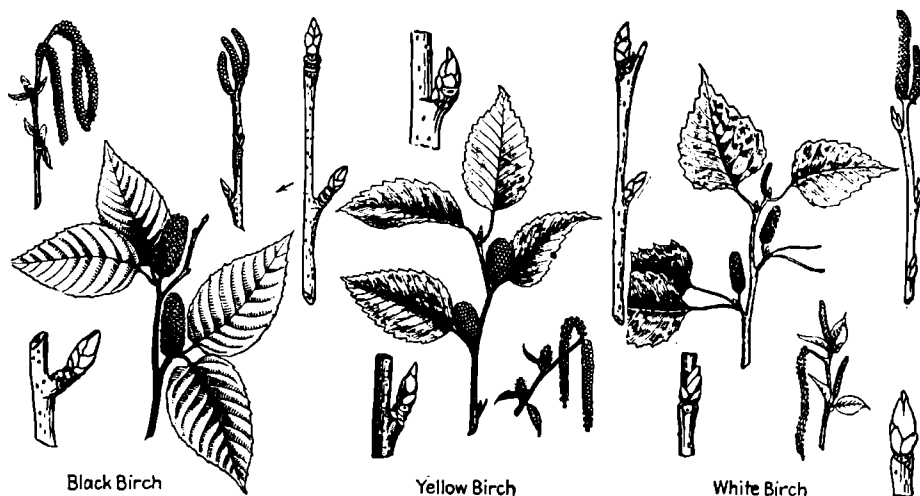
Tree to 40 ft. high, with a trunk to 2 ft. in diameter but commonly much smaller. Trunk short, fluted like "muscles"; close, bluish-gray bark. Crown open and round-topped, the branches ascending but drooping at tips. Twigs at first silky, then smooth, shining, reddish. Buds with to 12 visible scales, 4-ranked. Leaves to 4 in. long, deep green above.

Usually found near waterways and hence is known sometimes as "water beech," but may be found on hillsides where there is abundant water available. It is not a swamp tree, however. Ranges from Nova Scotia to Florida and west to Minnesota and Texas in suitable areas. Only 1 American species but several in Europe and northern and central Asia.

Flowers appear with leaves. Staminate in catkins that droop and are about 1½ in. long, though they first appear the preceding summer as large, long buds. Pistillate in short catkins about ¾ in. long with conspicuous bright red styles. Fruit a nut about ½ in. long with enclosing 3-lobed bract.

Wood diffuse-porous with conspicuous broad and narrow medullary rays, 45 lb. per cu. ft., light brown with large sapwood. Best distinguishing character aside from trunk and fruits is blunt, downy buds in place of sharp, smooth buds of hop hornbeam. Leaves turn orange or scarlet in autumn rather than yellow.

Tree has some merit as an ornamental but it is a slow grower and produces little volume of wood. Considered as weed species by foresters and is usually cut out to give room for more useful species. Wood makes excellent fuel and is good for tool handles and levers and is split to make binding material by woodsmen.



Black Birch

Yellow Birch

White Birch

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Fagales. Family Betulaceae

Black Birch, Sweet Birch

Betula lenta

Tree to 80 ft. high. Trunk diameter to 5 ft. Trunk usually continuous, but sometimes divided at a low point. Bark on old parts, dark, broken into large, irregular scales; on young parts, smooth, shining, close. Twigs with numerous short spurs, bearing crowded leaf scars, with wintergreen flavor. Leaves to 5 in. long and 3 in. wide.

Commonly on rich, dry soil on slopes, or even on rocky mountain slopes. Good-sized trees may be seen hanging precariously to edges of cliffs. From Newfoundland to Florida, west through Ontario to Illinois, south to Tennessee. Not found in pure stands but most common in mixed stands of other broad-leaved trees.

Staminate flowers appear with leaves in catkins that lengthen to 4 in. from winter forms $\frac{3}{4}$ in. long; catkins form in fall preceding maturity. Pistillate flowers in erect, slender catkins, to $\frac{3}{4}$ in. long, slender, and pale green. Cone-like, erect fruit develops to 2 in. long and persists, shedding winged fruits through winter.

Wood 47 lb. per cu. ft., diffuse-porous, with indistinct rays, dark-brown, heavy, strong, with thin, yellow sapwood, superior as firewood and has qualities that permit it to be used as a substitute for mahogany and cherry in making of furniture, takes good polish and holds stains well. Tree a slow grower; attacked by many fungi.

Wood makes superior fuel and furniture. Sap yields some sugar. Oil, from twigs and wood, used as wintergreen oil in medicines and soft drinks. May be valuable as oil producer. Excellent "tea" made by steeping shaved bark of twigs in hot water and sweetening. Important food of deer, moose, cottontails, and grouse.

Yellow Birch

Betula lutea

Tree to 100 ft. high, with trunk diameter to $4\frac{1}{2}$ ft. Growing in open, has short, thick trunk. Bark pale yellow, peeling off in thin sheets around trunk, but with loose ends hanging free; on old trunks, reddish-brown. Twigs green, then brown, then gray. Buds downier than in black birch. Leaves to 4 in. long, in pairs, but not opposite.

Common in moist woodlands, along streams and swamps, usually where there is a rich soil. Sometimes appears in small, almost pure stands. From Newfoundland to Minnesota, south to North Carolina and Tennessee. This species may be one of largest eastern American trees that sheds its leaves.

Staminate flowers appear with leaves after forming in fall, developing from $\frac{3}{4}$ -3-in. catkins when pollen is to be shed. Pistillate flowers in short, erect, cone-like structures, about $\frac{3}{4}$ in. long, with acute scales, that are red and hairy above, green below. Fruit borne in erect, cone-like structures, $1\frac{1}{2}$ in. long, that shed winged nutlets.

Wood diffuse-porous, 70% as hard, 50% as strong as white oak, with indistinct rays, 41 lb. per cu. ft., compact, but not durable in contact with soil. Heartwood light brown with a red tinge. Sapwood paler. Wood used in making flooring, furniture, interior finish, crates, veneers. Some oil is distilled from it.

Not recommended by foresters for encouragement since most of its associates yield superior fuel and lumber in shorter time, but where it comes up naturally it can well be used. Campers welcome tree because its loose bark makes an excellent tinder for starting fires and wood, when sound, makes good fires with a good bed of coals.

White Birch

Betula alba

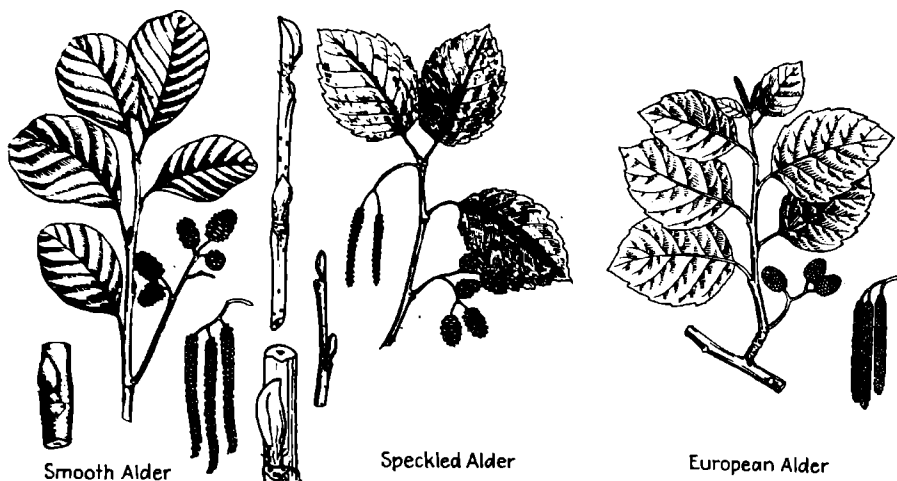
Tree to 80 ft. high, with a trunk diameter to 3 ft. Bark close, chalky white, peeling off in horizontal bands, paper-thin, with a yellow tinge on inner side of peeled-off band. Twigs stoutish except in some varieties, finally smooth, reddish-brown before becoming white. Leaves to 3 in. long and to 2 in. wide, sharp-pointed.

Found in rich woodlands, most commonly near waterways, often among hardwoods. From Newfoundland to Alaska, south to Pennsylvania, Michigan, Colorado, and Washington. European white birch grown as ornamental over wider range and farther south. Many varieties including cut-leaf and drooping branched forms.

Flowers appear just before leaves. Staminate, in groups of 2-3 catkins, each to 4 in. long, but starting in spring at about 1 in. long. Pistillate in clusters, to $1\frac{1}{2}$ in. long, with green scales and red tips. Fruits like cones, hang downward, about $1\frac{1}{2}$ in. long, producing small, winged nutlets.

Wood diffuse-porous, with inconspicuous medullary rays, 37 lb. per cu. ft., strong, light, hard, brown, tinged with red, with thick, light sapwood. Ornamental European white birch is victim of a beetle that bores into trunk and kills tree, so species, common early in century, has about disappeared, but is still planted.

Of much economic importance for dowels and spools. Formerly main sources of bark for Indian canoes. Still used in making woodcraft novelties and rustic furniture. Should not be peeled unless tree is to be destroyed, since beauty of tree is destroyed. Wood is excellent firewood. Eaten by 12 bird species and by deer, rabbits, and stock.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Betulaceae

Smooth Alder
Alnus serrulata

Small tree or shrub, to 10 ft. high forming dense thickets, in shallow marsh water, or along stream edges. Bark thin, brownish-green, smooth, becoming gray-green or blotched with gray. Buds slightly but plainly stalked. Leaves alternate, smooth or only slightly fuzzy beneath, rarely with impressed nerves. Stipules oval.

Along streams and close to waterways in northern part of range, usually near sea but in South more widely distributed. From Maine to Florida, and west to Texas and Minnesota. Rarely present along streams that flow over limestone or lime deposits, therefore abundant near bogs and waters full of plant wastes.

Flowers in catkins, appearing before leaves, with staminate and pistillate in separate catkins on same twig. Staminate develop somewhat preceding fall, being in 1-in. catkins in winter and in clusters of 2-5. Pistillate in catkins, to $\frac{1}{2}$ in. long, and in groups of 2-3. Fruits winged, in $\frac{3}{4}$ -in., woody cones.

Wood diffuse-porous, but with growth rings distinct. Medullary rays variable in width. Sapwood yellow-brown after exposure to air. Pith of twigs distinctly triangular in outline, green in color. Best characters to distinguish it from speckled alder are those given for leaves and fruits.

Probably of considerable importance in anchoring streams to their beds, in providing shelter for trout. A favored food of beaver, which use bark for nourishment and sticks for their dams and dwellings. These dams are important in flood control and in soil building.

Speckled Alder
Alnus incana

Shrub or small tree, sometimes reaching a height of 20 ft., frequently forming a dense tangle. Bark bronze-brown, more lustrous than in smooth alder, and much more spotted with lenticels, usually lacking gray blotches on older bark. Leaves with impressed nerves and usually, but not always, with undersides fuzzy at least along veins.

Common in swamps and along streams, particularly those that are small. From Newfoundland to Saskatchewan, south to Pennsylvania, Iowa, and Nebraska and present but rare along coastal plain where smooth alder is more representative. Distinctly more northern in distribution than is smooth alder. Speckled alder is Eurasian.

Flowers much like those described for smooth alder. While staminate and whole general flower-producing areas are nodding in both smooth and speckled alders, pistillate clusters are erect in smooth alder and nodding in speckled alder. Winged fruit of speckled alder is round, while it is oval in smooth alder.

Woods of smooth alder and speckled alder, essentially alike. They cut easily, but regenerate abundantly by means of suckers from the roots or from thickets from shoots arising from branches that may have become prostrate in winter and buried in the spring freshets.

Economic importance of smooth alder and speckled alder is essentially same, and of little direct value, though plants are definitely associated with important changes in the plants, animals, and soils of the areas in which they live.

Alder
Alnus tenuifolia

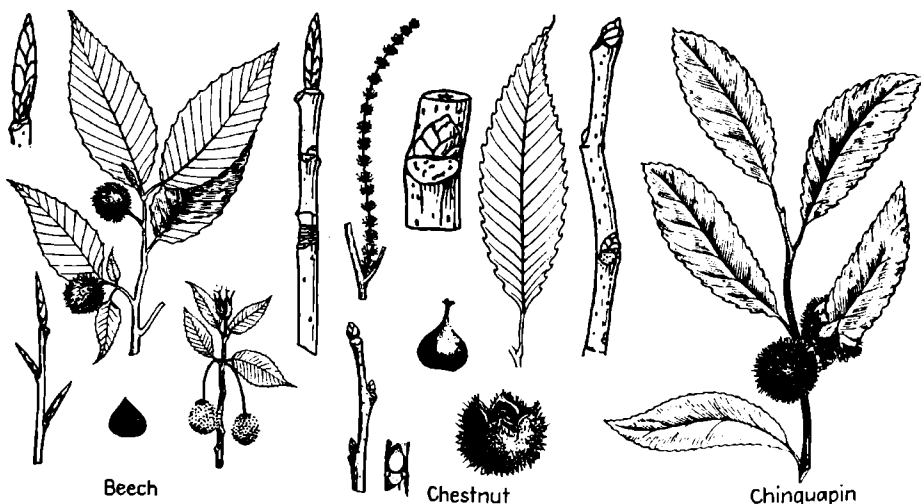
Tree reaching a height of 30 ft., with trunk diameter up to 8 in. In northern part of range, rarely over 5 ft. high. Bark over $\frac{1}{4}$ in. thick, bright reddish-brown, with small, closely pressed scales on surface. Buds bright red, to $\frac{1}{8}$ in. long. Leaves to 4 in. long and to $2\frac{1}{2}$ in. wide, smooth, or mealy on underside.

Found along banks of waterways, north to Fraser River in British Columbia, east along Saskatchewan to Prince Albert, south to New Mexico. Common alder of eastern Oregon, Washington, Idaho, and Montana; reaches largest size in Colorado and New Mexico. European alder a tree, *A. vulgaris*. Red alder, *A. rubra*, West Coast lowland species.

Flowers much like other alders. Staminate catkins, in winter light purple, to 1 in. long, becoming 2 in. long when mature. Stamens, 4. Pistillate flowers naked in winter, dark-brown, to $\frac{3}{4}$ in. long. Fruit woody, cone-like, to $\frac{1}{2}$ in. long. Nutlet nearly circular and surrounded by a thin membrane border. Flowers open in winter or early spring before opening of leaves.

Forms great thickets much as do smaller shrubs and trees that are its close relatives in East. Wood, diffuse-porous. In southern California found at elevations up to 7,000 ft. along headwaters of most rivers flowing from California into the Pacific. Wood of related *A. glutinosa* is an important hardwood; that of red alder, *A. rubra*, hard and red.

Chief role that of anchoring banks of streams and helping prevent soil erosion. As with other alders, shade delays melting of snows in highlands; contributes to flood control. Related European alder, grown as ornamental tree and has become established in some areas in eastern United States. Wood of *A. rubra* a good mahogany imitation.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Fagaceae

Beech

Fagus grandifolia

Tree to 125 ft. high; trunk diameter, to 4½ ft. Bark, close, light gray, smooth, with dark mottlings, relatively thin, commonly carved with initials. Twigs slender, dark yellow to gray, zigzag, with spreading, slender, long pointed buds. Roots spreading, giving rise to shoots. Leaves to 4 in. long, leathery, long-persistent.

Commonest on rich bottom lands or on fertile highlands. From Nova Scotia to Ontario and Wisconsin, south to Florida and Texas. Favors gravelly slopes and fails to thrive where there is an abundance of limestone or of water that has passed over limestone. Forms relatively clear stands. Related European beech resembles it.

Flowers appear in April, when leaves are ¼ developed. Staminate flowers in stalked, round head, about 1 in. through; pistillate, in 2-flowered clusters, in axils of upper leaves. Trees begin bearing relatively late, sometimes not until 13 years old. Fruit: small, spiny bur, with 2 pale tan, sweet-meated nuts, germinates fall or spring.

Wood 90% as hard, 71% as strong as white oak, but does not weather well, weighs 42 lb. per cu. ft., diffuse-porous, with broad, conspicuous medullary rays, alternating with small, inconspicuous ones. Highly susceptible to leaf blight, bark canker, and nuts too frequently infested with insect parasites. Trees not easily transplanted.

Wood used commonly in furniture and in tool handles. Makes excellent fuel, and diseased trees are important source of fuel. Nuts were formerly important and delicious food for man and hogs, and wild turkeys fattened on them. Nuts may be crushed; extracted oil useful in cooking or in food for animals. Eaten by 15 bird species, by foxes, squirrels, bears, and deer.

Chestnut

Castanea dentata

Tree to over 100 ft. high, with trunk diameter to exceed 10 ft. Old bark gray, with long, coarse furrows. Bark on younger branches, closer, smoother except where disease-infected. Twigs smooth, greenish-brown, with ¼-in. buds, covered by 2-3 dark-brown scales. Leaves to 8 in. long, and 2 in. wide, with sharp-pointed teeth, along margins. Roots deep.

On hillsides, on relatively poor soils that are well-drained and commonly associated with maple, beech, and similar trees. From southern Ontario to northern Georgia, west to Mississippi and Michigan but practically gone from east of mountains except as saplings and suckers that die about time first nuts are produced.

Flowers appear in late spring, after leaves, staminate in loose, slender, crowded catkins, to 5 in. long; pistillate clusters, near base of staminate. Fruits mature in September and October, with prickly bur enclosing 2-3 plump, russet nuts, pointed at top, and thin-shelled. Nuts germinate spring following planting.

Wood to 28 lb. per cu. ft., relatively coarse, strong, light, easily split, durable when exposed to the weather. Chestnut blight *Endothia parasitica* has killed most trees in eastern part of range. A leaf blight may also be serious. Trees were formerly budded and grafted to improve quality and quantity of yield.

Both nuts and wood formerly had high commercial value. Nuts were harvested, stored, roasted, boiled. Meal made from nuts was used by Indians and early settlers and wood provided interior trim and heavy construction in many buildings within range. Blight-resistant varieties or hybrids may be developed that will restore species to usefulness.

Chinquapin

Castanea pumila

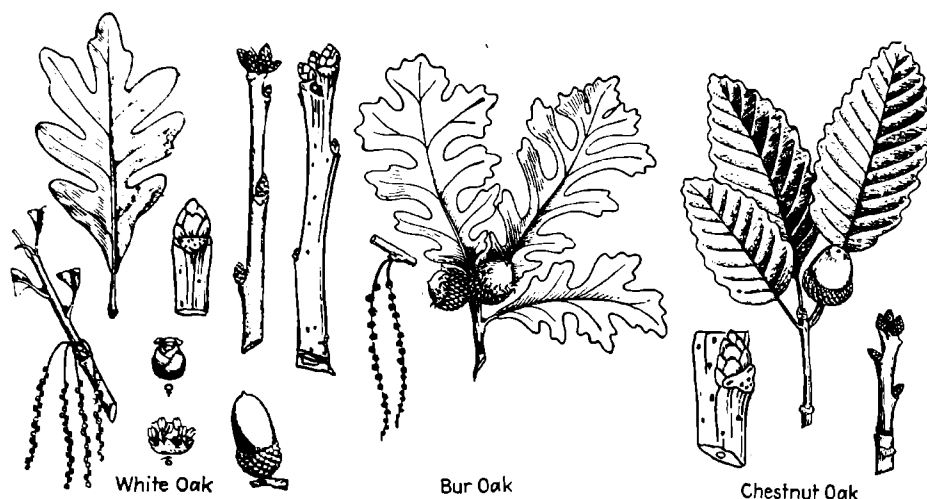
C. pumila, round-topped tree, sometimes to 50 ft. high, with trunk diameter to 3 ft., but often a mere shrub. Bark to 1 in. thick. Twigs slender, woolly when young, smoother when mature, with red-scaled buds. Leaves to 5 in. long, to 2 in. wide. Other chestnuts, European chestnut, *C. sativa*; Japanese chestnut, *C. crenata*, et al.

C. pumila native New Jersey to Florida, west to Missouri and Texas, where it is found on dry, sandy slopes. European chestnut cultivated in Europe. Japanese chestnut grown in Asia, is possible cross with native chestnuts that may be worth developing. *Castanopsis chrysophylla*, the golden-leaved chestnut, or chinquapin, is from Pacific Coast.

C. pumila bears staminate flowers in spreading catkins in May or June, and pistillate at base of upper catkins. Fruits, burs, with stiff spines, enclosing 1, or rarely 2, sweet, bright brown nuts. Nuts sprout soon after they fall in autumn. Because of this, chinquapins do not do well in North, since new wood cannot set before severe weather.

Chinquapins do not reach great size of chestnuts so have little value as wood. Wood to 28 lb. per cu. ft., hard, brown, durable, strong, and splits easily. Nuts may be badly infested with a nut weevil in South, but tree is relatively resistant to chestnut blight, and hybrids between chinquapin and chestnut may solve blight problem.

European chestnuts highly susceptible to blight. Japanese chestnut too coarse to be popular. Chinese chestnut of superior quality, and relatively resistant to blight. Chestnuts used in flour or in stuffing for fowls; too good to be lost to man completely. Chinquapins or Chinese chestnuts or some naturally resistant strain may improve the species.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Fagaceae

White Oak
Quercus alba

Tree to 75 ft. tall, with trunk to 6 ft. in diameter; tall, in open, 2-3 times as broad as tall, with gnarled branches. Roots deep. Bark light gray, broken into long, thin, irregular scales. Twigs with star-shaped pith, medium thick, with a bloom first winter, then gray. Buds to $\frac{1}{4}$ in. long, dark, reddish-brown, rather blunt. Leaves to 9 by 4 in.

In dry upland soils or at best on well-drained, deep, higher bottom lands where there is adequate moisture. Ranges from southern Maine to Minnesota, southward to Florida and Texas, sometimes forming rather extensive and pure forests. Commonly found mixed with other oaks, hickory, basswood, yellow poplar, red gum, black cherry, white ash and other species.

Staminate flowers in catkins to 3 in. long, yellow. Pistillate flowers bright red, scattered or clustered. Pollination by wind. Fruit an acorn, to 1 in. long, $\frac{1}{4}$ enclosed in light, chestnut-brown cup, with thick, warty scales. Acorns ripen in October, 208 per lb., 25-90% germination; planted $1\frac{1}{2}$ in. deep, to 6 in. apart, grow to 9 in. first year.

Wood strong, ring-porous, durable, 46.3 lb. per cu. ft., light brown, requires 4,425 lb. pressure per sq. in. to shear, with thin, light brown sapwood; close-grained, tough, hard. Not a fast grower but may live to 600 years, being less tolerant to enemies in old age. Acorns germinating in fall may freeze unless they have been buried by squirrels.

Important wood for heavy construction, floors, furniture, cabinet work, tool handles, baskets, railway ties, fences, fuel. Seton believes that spread of this oak is largely dependent on a sustained squirrel population. Acorns were used as food by Indians, and early settlers boiled them and used them as food when necessary.

Bur Oak
Quercus macrocarpa

Tree to 170 ft. high, with trunk diameter to 7 ft. though normally smaller. Bark darker than in white oak, with more vertical ridging, to 2 in. thick; scales often reddish. Twigs corky at first with pale gray fuzz but usually smooth by first winter. Buds to $\frac{1}{4}$ in. long, with light red-brown scales. Leaves to 12 by 6 in., on 1-in. petioles, hardly smooth.

Best on dry clay soils. Extends farther northwest than other eastern oaks. Appears as shrub in Rocky Mountain foothills. Ranges from New Brunswick to Delaware and west to Texas and Wyoming and North Dakota. Grown as an ornamental in many parts of eastern United States and in South Africa. At its best in Ohio River valley.

Staminate flowers in catkins to 6 in. long, with pale, matted hairs. Pistillate on same tree, red tinged, stalked or stalkless. Fruit, a solitary, usually stalked nut, to 2 in. long, broad, egg-shaped, downy at tip and enclosed $\frac{1}{2}$ or more by deep fringed cup, a character that gives tree the name bur oak or mossy-cup oak.

Wood very durable, heavy, strong, hard, close-grained, dark, rich brown, with thin, lighter sapwood, rough. A common associate of such bottom-land species as elm, soft maple, pin oak, willow oak, red gum, and cypress and has a high resistance to injury by smoke and gases from industrial and fuel plants.

Grown sometimes as an ornamental and particularly within its range where there is danger of smoke injury. Wood used as is the wood of many other kinds of oaks. It will survive on soils too poor and dry to support some of the better hardwoods and so represents a good product of such soils.

Chestnut Oak
Quercus montana

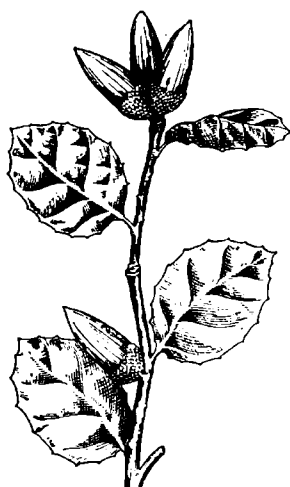
Tree to 70 ft. high, with trunk to 3 ft. in diameter, tall and columnar, or open branching. Bark thick, brown to black, fissured into deep broad ridges. Roots deep. Twigs stout, orange to brown. Buds clustered at tip, sharp-pointed, with scales light brown, and hairy at apex. Leaves to 9 by 5 in., with coarsely rounded shallow lobes.

On dry, poor, rocky soils, sometimes in pure stands but often associated with black oak, chestnut, and pitch pine. Ranges from southern Maine to northern Alabama and Georgia and west to northeastern Mississippi, Illinois, Michigan, and southern Ontario. In southern part of range, is found at elevations of 4,500 ft.

Flowers borne separately on same tree; staminate, in yellow-green catkins to 4 in. long; pistillate, pale or dark red, in dense spikes. Fruit acorn, to $1\frac{1}{2}$ in. long, shiny, egg-shaped, $\frac{1}{2}$ - $\frac{3}{4}$ enclosed at base in thin cup whose scales are somewhat grown together; 184 to pound; 25-90% germination; grows to 10 in. first year.

Wood stout, heavy, 47 lb. per cu. ft., ring-porous, durable, hard. Bark higher in tannin than in other oaks and is used with tannin from hemlock to offer the red of the hemlock tannin. Unable to compete successfully with other oaks whose wood is of superior quality on the richer soils.

Chief use is as an important source of tannin for use in leather industry and in arts. Wood used as a substitute for white oak, in making railroad ties, fencing, fuel, and heavy construction timbers. Leaves often bear an interesting bullet gall. Old wood commonly parasitized by a white wood rot (*Polyporus*).



Coast Live Oak



Live Oak



Cork Oak

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Fagaceae

Coast Live Oak
Quercus agrifolia

Forest tree growing to 90 ft. Trunk diameter to 6 ft., the trunk generally dividing low into crooked heavy branches. Leaves stay on for 1 year; 1-4 in. long, oval, rather coarse and heavy. Twigs hoary for 2 seasons. Bark brown to black and deep-furrowed.

Found in dry loams or gravelly soils of open slopes from sea level to 4,500 ft. elevation from San Francisco south to Lower California and rarely more than 50 miles from coast. If near salt water and exposed, becomes more shrubby in appearance.

Flowers appear in early spring. Pollination by wind. Fruits maturing in 1 year into acorns 1 in. long, with cup over the lower $\frac{1}{4}$ or $\frac{1}{2}$ the nut, having silky, closely pressed scales. Seedlings may develop under moderate cover, and, while growth is not rapid, maturity may be reached in 150 years.

Trees often found in almost pure stands, alone in the open or mixed with other trees. May be associated with California sycamore, big-cone spruce, and white alder. Trees are too distorted to produce any great amount of clear lumber, but they produce great quantities of acorns.

Acorns of this and of some other oaks, including swamp white oak, chestnut oak, basket oak, and white oak are edible. Indians, especially in West, ground the meat, either before or after roasting, and sometimes removed tannin by soaking in water. From this, flour cakes were made which, according to John Muir, were most valuable food for hiking trips.

Live Oak
Quercus virginiana

Tree. Height, to about 50 ft., but with crown to 150 ft. across, trunk being to 4 ft. through. Bark dark, reddish-brown, with small surface scales and small furrows. Twigs slender, brown to gray, with buds about $\frac{1}{8}$ in. long, and with white-margined, brown scales. Leaves persistent for 1 year, to 5 in. long and $2\frac{1}{2}$ in. wide, glossy green above.

At best on moist, sandy plains. On dry lands, may be only 1 ft. tall. Does well on flooded lands. Ranges from Virginia to southern Florida and west along Gulf coast through southern Mississippi, southern Louisiana, on to the Rio Grande in Texas, north to central Texas. In Cuba and Mexico. Most important live oak in East.

Flowers staminate, in hairy catkins to 3 in. long; pistillate, in fuzzy spikes, on stems to 3 in. long; stigmas, bright red. Fruit in clusters of 3-5; a nut about $\frac{3}{4}$ in. long, dark-brown to black, $\frac{1}{2}$ enclosed in cup that is reddish-brown. Tree in Georgia grew to $4\frac{1}{2}$ ft. trunk diameter in under 70 years and may live apparently to over 300 years.

Wood one of heaviest of native woods, strong, requiring 8,480 lb. per sq. in. to shear in contrast to hickory 6,045; ebony, 7,700; black walnut, 4,700; and chestnut, 1,500 lb. Wood rough, durable in various situations. Some trees compound, having a combined buttressed trunk diameter of to 8 ft., with wide, horizontal branches.

Valuable tree for shipbuilding, one of best but now used mostly for tool stock and as ornamental shade tree. Acorns apparently vary in their quality and some of sweeter forms were considered edible by Indians. From them, they produced an oil similar to olive oil. Trees only 1 ft. high may bear fruits in some places.

Cork Oak
Quercus suber

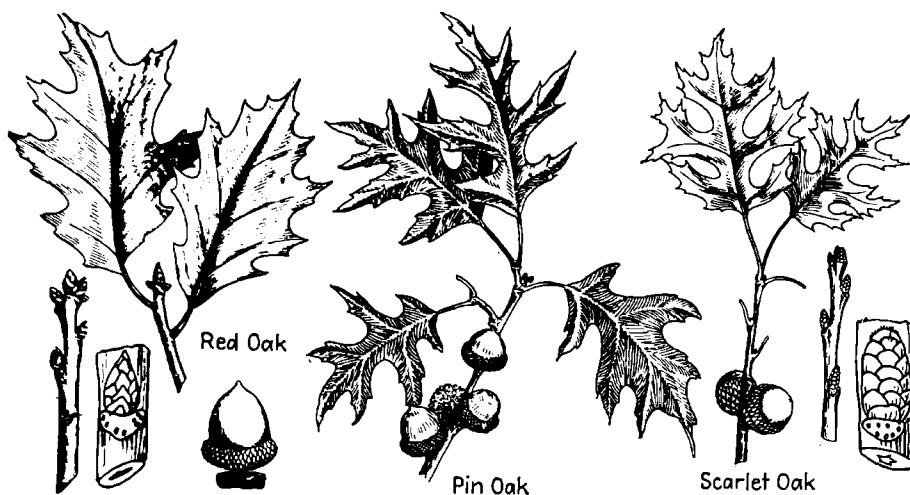
Tree. Height to 60 ft., with a trunk diameter of 4 ft., crown, densely spreading. Bark thick, and the most important part of tree to man. Its nature is to be seen in average commercial cork used in bottles. Leaves evergreen, ovate to oblong, sparingly toothed, smooth above, and whitish fuzzy beneath; to 3 in. long.

Native from Atlantic to Asia Minor but especially abundant in Portugal, Spain, Algeria, Tunisia, Corsica, southern France, and Morocco, occupying some 4 million acres of forest lands. Also is cultivated in India and in United States, on plantations in California, New Mexico, and Arizona. Obviously favors warm, dry climate.

Fruit a short-stalked acorn, egg-shaped, to $1\frac{1}{2}$ in. long, $\frac{1}{3}$ - $\frac{1}{2}$ enclosed in a thick-scaled cup whose scale tips are recurved. 60,000 vigorous young cork oaks were planted in America about 1940, and 150,000 when war broke out. First California tree to be stripped yielded 151 lb. of ground cork. Tree lives about 500 years.

Bark is removed down to inner bark at 20 years, usually working first 6 ft. of trunk but sometimes more. New crop is harvested about every 9 years, an average yield per tree varying from 40-500 lb., best quality coming from young vigorous trees though first harvest is usually coarse and poor.

Some 500 million pounds of cork are produced a year, of which United States imports about 1 million pounds. Used in making bottle stoppers. Linoleum is made of cork, linseed oil, and burlap. Linotiles are coarser tiles of cork and linseed oil. Cork tiles are made by baking cork under pressure. Valuable insulating agent.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Fagaceae

Red Oak

Quercus rubra (borealis)

Tree. Height to 150 ft., with a trunk diameter of to 5 ft.; trunk shorter in trees grown in open. Bark on old parts broken by shallow fissures with distinctly flat-topped ridges. Inner bark light red. Twigs smooth, with buds to $\frac{1}{3}$ in. long, pointed. Leaves to 9 in. long and to 6 in. wide, dull green, with reddish midribs.

On sandy, porous, clay or gravel soils, in sun. Ranges from Nova Scotia to Minnesota, south to Florida and Texas but planted extensively in Europe and elsewhere for forestry purposes. Common as a shade tree. Red or black oaks have furrowed bark, pointed buds, leaves with bristle-tipped lobes, and fruits maturing the second year.

Flowers appear when leaves are about half-developed. Staminate flowers in slender, hairy catkins to 5 in. long, with 4-5 stamens. Pistillate on short stalks. Develop acorns to $1\frac{1}{4}$ in. long, flat at base, in a broad, shallow cup, with basal scales apparently in 3 rows reaching $\frac{3}{4}$ way up cup.

Wood ring-porous, with conspicuous medullary rays, thin, light sapwood, and heavy, strong, hard, close-grained, light reddish-brown heartwood, weighing 41 lb. per cu. ft. Tree a relatively fast grower and remarkably free from serious insect and fungus pests. Acorns harvested in April, 128 to a pound; germination 75-95%.

In nurseries, young trees reach height of 20 in. first year if planted at depth of $1\frac{1}{2}$ in. 3-6 in. apart. Tree may reach height of 18 ft. in 10 years; 39 ft. in 20 years; 57 ft. in 50 years. Excellent shade tree. good fuel tree and good for heavy construction, railroad ties, interior decoration, cooperage, and furniture.

Pin Oak

Quercus palustris

Height to 150 ft. Trunk to 5 ft. in diameter. Many short stubby branches or branchlets stick out from branches. Bark gray-brown, smooth at first but eventually with low scaly ridges. Leaves alternate, to 5 in. long and to 5 in. wide, with 5-7 narrow, bristle-tipped lobes, smooth above and below except in axils of veins.

Native of North America. Found in bottom lands from Connecticut to Virginia, west to Arkansas and Iowa. In black oak group. Differs from typical black oak by having leaves with smooth undersurfaces except for tufts in vein axils there.

Flowers: staminate and pistillate flowers are borne separately on same tree, staminate being in loose hanging catkins, pistillate in short, rather stiff spikes. Fruit, an acorn about $\frac{1}{2}$ in. long with meat of kernel bitter and nut resting in a thin, saucer-like cup; acorn 2-3 times as long as cup.

Flowering time from May-June; acorns are borne and ripen second season in September and October. Wood weighs 43 lb. per cu. ft., hard, coarse-grained, strong, knotty, light brown. Subject to attacks of many twig-gall makers; galls can often be collected in great abundance from the tree.

Name pin oak comes from practice of using the stiff pin-like spurs as pins to fasten timbers together, before nails were generally used. Tree is commonly grown as an ornamental because it survives transplanting better than many other oaks and also because it is in itself an attractive tree. Closely resembles jack oak, *Q. ellipsoidalis*.

Scarlet or Spanish Oak

Quercus coccinea

Tree of medium size, usually to 80 ft. high but sometimes to 100 ft., with trunk diameter to 4 ft., with small, spreading branches making open crown. Bark light brown to black, with irregular ridges separated by shallow fissures. Buds to $\frac{1}{4}$ in. long, red-brown and fuzzy above middle. Leaves to 6 in. long and 4 in. wide, with 7-9 deep lobes bearing sharp points.

On dry sandy soils, often in almost pure stands or mixed with oaks and hickories. Native from Androscoggin River valley in Maine to Georgia, west to Wisconsin and Oklahoma, reaching to altitude of 5,000 ft. in southern mountains and to 2,500 ft. in Blue Ridge where it is prevailing oak. Grown as an ornamental rather widely in America and in Europe.

Staminate flowers in slender catkins, to 4 in. long. Pistillate flowers bright red, on fuzzy $\frac{1}{2}$ in. stems. Fruit usually borne singly or in pairs; a nut, $\frac{1}{2}$ -1 in. long, oval, hemispherical, or globose, red-brown, $\frac{1}{2}$ - $\frac{3}{4}$ enclosed in a deep, bowl-like cup whose scales are shining, red-brown and closely pressed at tips. Flesh of acorn nearly white. Acorn with concentric rings.

Wood heavy, coarse-grained, ring-porous, strong, light or reddish-brown, with thicker, dark-colored sapwood. Although wood is one of poorer grades of oak, trees are cut and wood mixed with other red oaks in trade, although where there is too much scarlet oak the product may not always bring highest prices.

Used primarily as an ornamental and shade tree since it has marvelous beauty, particularly in fall, and since it responds rather well to horticultural manipulations that modify form for many desired purposes. Hardy, relatively free from attacks of more destructive insect pests, and therefore requires a minimum of care when established.



Black Oak



Shingle Oak



Tan-bark Oak

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Fagales. Family Fagaceae

Black Oak

Quercus velutina

Tree to height of 150 ft.; trunk diameter, 4½ ft. Upper branches ascending; lower, horizontal. Bark dark, deep-fissured between thick ridges that are cross-fissured. Inner bark yellow, bitter. Twigs stout, angular, with sharp-tipped, angled buds, with dirty-white to yellow fuzz. Leaves to 6 in. long and 4 in. wide, highly variable, thick.

Found on dry uplands or gravelly plains or in sandy soil, but rarely in rich lowlands. In West, mostly on poor upland soil. Range from Maine to western Minnesota and south to Florida and Texas. Best distinguishing characters are inner bark, cup of fruit, woolly buds, highly variable leaves that are frequently widest toward tip.

Flowers appear when leaves are about ¼ developed. Staminate, in hairy catkins, to 6 in. long. Pistillate, on short, hairy stalks. Fruit an acorn maturing the second season, to 1 in. long, light reddish-brown, covering about ½ the nut, forming a fringe-like margin to the top.

Wood ring-porous, with conspicuous medullary rays, hard, heavy, strong, durable, not tough, checks readily, weighs about 44 lb. per cu. ft. Heartwood light brown; sapwood, lighter brown. Not an attractive ornamental or a superior timber tree. Acorns mature in October, are collected in March, germinate 75-95% if planted at depth of 1½ in., 3-6 in. apart.

Wood used in cooperage, in furniture, in heavy construction, for interior finish. Speed of growth next to that of red oak. Bark used in tanning industry. Tree sprouts persistently and individuals rarely found over 200 years old. May go several years without bearing acorns. Usually with deep taproot, therefore poor as a transplant.

Shingle Oak

Quercus imbricaria

Tree. Height to 100 ft. with trunk diameter to 3½ ft. Trunk seems to be short and crown rounded. Leaves alternate, to 6 in. long and to 2 in. wide, dark, shining green above, pale brownish and downy or hairy beneath, margins slightly wavy; in this respect unlike most other oaks, with short bristle at tip like red oaks.

Native of North America and found near streams, mixed with other hardwoods or on moist hillsides from New Jersey to Georgia and west to Arkansas and Nebraska, but not found on Atlantic coastal plain. Belongs to red-oak group and a small subgroup that have willow-like or laurel-like leaves.

Flowers staminate and pistillate, borne separately on same tree with staminate in catkins, pistillate in short, relatively stiff spikes. Fruit an acorn about ¾ in. long, maturing second autumn, somewhat more than half enclosed in cup that is relatively deep and has reddish-brown scales.

Flowering time April to May; fruiting time, the fall of second season. Wood weighs 47 lb. per cu. ft., light reddish-brown, hard, coarse-grained, of comparatively little value except as firewood. More common in southern than in northern part of its range.

Name shingle oak may have come from fact that early botanist Michaux is reported to have found the natives making shingle shakes from its wood. It probably is inferior to many other species for this purpose.

Tanbark Oak

Lithocarpus densiflora

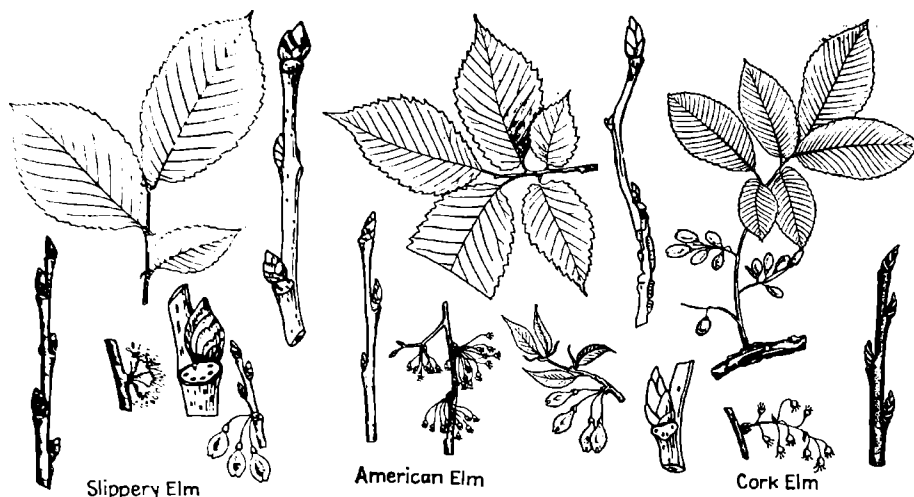
Tree to 150 ft. high, with trunk to 5 ft. in diameter. Trunk of trees grown in open often grotesque, bearing wide-spreading branches. In close formation may have narrow top. Roots deep taproots, with laterals. Bark of heavy rounded ridges, with deep narrow fissures. Twigs densely fuzzy at first. Leaves persistent, light green above, brown woolly beneath.

Does best in deep, rich, moist, well-drained, sandy or gravelly soils, often in association with Oregon white oak, California black oak, chinquapin, Douglas spruce, redwood. From southern Oregon, south along coast ranges to Santa Ynez Mountains in California, south in Sierra to Mariposa County, from sea level to elevation of 5,000 ft.

Flowers appear in early spring and resemble those of chestnut, with catkins to 4 in. long. Fruit solitary or in pairs, to 1 in. long, an acorn partially or wholly enveloped by cup, maturing at end of second season. Trees begin bearing fruit by thirtieth or fortieth year and mature at 200-300 years.

Wood hard, strong, brittle, like chestnut, reddish-brown, with thick, dark sapwood; close-grained. Tree does well in humid area that supports redwood, particularly in San Francisco Bay area. Can exist under shade of other trees throughout its lifetime. When competition is removed, growth and development are phenomenal.

This is the tree used on West Coast as the principal local source for tannin. The wood is used mostly as fuel although it has many of the properties of good timber if the trees were of the type to yield straight stock. The normal development is of average rapidity.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Urticales. Family Urticaceae

Red Elm, Slippery Elm

Ulmus rubra

Tree to 60 ft. high, with trunk to 2½ ft. through. Branches relatively horizontal and short, without usual droop of American elm; gray, and with buds whose scales show rusty hairs distinctly. Leaves with margins doubly toothed and with surface conspicuously roughened.

Does best in rich woodlands where there is good water and drainage. Found from southern Quebec to southeastern South Dakota, south to eastern Texas and Florida. Limestone country seems to be favored by this tree. Grown in some places as an ornamental because it occupies less space than American elm though it lacks its grace.

Flowers bear both stamens and pistils, appear before leaves in spring, each on a short stem. Fruits mature as leaves appear and become ¾-in. wafers, with thin, papery, wing margin that is smooth. Not common in pure stands but grows best with such trees as yellow poplar, basswood, white ash, butternut, and other elms.

Wood heavy, 45 lb. per cu. ft.; hard, strong, tough, durable, dark-brown, easily split for an elm, tends to twist out of shape in curing; makes fair but not superior fuel. Bark yields from its inner layers a mucilage used medicinally in gums or lozenges to soothe inflamed tissues, and gives off unique odor.

Tree used as an ornamental. Wood used for fuel and in coarse construction work and for other uses typical of elms. Inner bark yields a fiber useful in making shoe lacings and cordage, also the mucilaginous medicine for sale in drugstores in a ground or processed form. Bark used by Indians in making canoes like birch-bark canoes. Buds are bird food.

American Elm

Ulmus americana

Tree to 100 ft. high, with trunk diameter to 5 ft. Usual form a branching vase shape. Bark thick, grayish, roughened, and irregular, with furrows and ridges not continuous. Twigs fine, brown, with alternate egg-shaped, few-scaled buds. Leaves with upper surface somewhat roughened, and base usually uneven.

Does best on rich bottom lands or where springs supply an abundance of subterranean water. From Newfoundland, west through Canada to Rocky Mountains, south to Florida and Texas but planted widely elsewhere as a shade tree. Through East is one of most popular shade trees but may eventually be destroyed by Dutch elm disease.

Flowers appear before leaves, in slender, drooping clusters, each flower with stamens and pistils. Fruit matures shortly after flowering or about as leaves develop; a ½-in. wafer, with a papery margin, notched at apex, hairy on margin; 94,000 to the pound; 50-75% germination; planted to depth of ½ in., reaches height of 10 in. first year.

Wood heavy, 40 lb. per cu. ft., strong, tough, coarse-grained, hard to split, with a tendency to bend in curing; ring-porous. Bark used as emergency rope and may be peeled off in strips to make shelters, or inner bark may be boiled and stripped off to be used as chair-bottom material. Cankerworms and elm leaf beetles may be serious pests.

Chief use is as an ornamental shade tree, largely because of graceful arching canopy formed over streets when tops meet. Dutch elm disease should be controlled to save this tree. Buds serve as emergency food for some birds including such game birds as pinnated grouse.

Cork Elm, Rock Elm

Ulmus thomasii

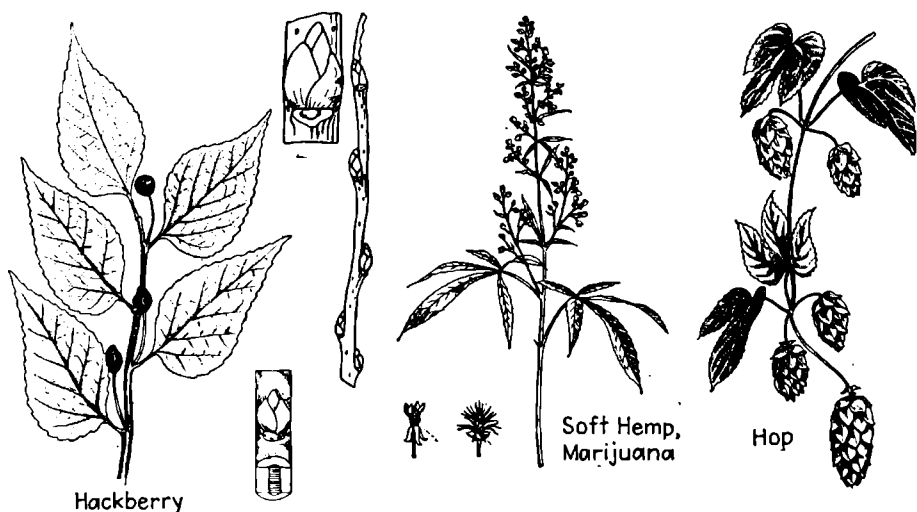
Tree reaches height of 100 ft., with a trunk diameter of 3 ft. Trunk divides less than in most elms, often running undivided nearly to top of crown. Bark dry, thin, close, flaky, and, on twigs, found in corky wings or ridges. Leaves to 4½ by 2¼ in., coarsely doubly toothed, usually smooth above, and hairy beneath.

Favors gravelly ground such as banks of rivers and hills but where there is ample water supply. Ranges from Quebec to Minnesota, south to New Jersey and Nebraska. Grown to some extent outside this range as an ornamental. Like American elm, it favors areas where there is an abundance of underlying limestone.

Flowers bear both stamens and pistils, appear before leaves in spring, clustered along a central stem instead of at a common point as in other elms. Fruit matures as leaves unfold, as a ¾-in. wafer with encircling hairy wing with margin of seed cavity indistinct as compared with other elms.

Wood tough, heavy, hard, strong, light or reddish-brown and in many respects much like that of slippery elm. Victim of a leaf-spot disease and its leaves are preyed upon by elm leaf beetle so destructive to other elms. Straight form of trunk makes it possible for this tree to develop better timber than other elms.

Used primarily as shade tree; wood used for fuel and for lumber for particular uses such as wagon spokes, tool handles, and some kinds of furniture; also common in cooperage such as barrels, barrel hoops, hubs, ties, and baskets. Fruits gathered in great quantities and eaten by many squirrels.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Urticales. Family Urticaceae

Hackberry
Celtis occidentalis

Tree. Height to 120 ft.; trunk diameter, to 4 ft. General shape short and bushy, with rounded crown, though it may vary considerably. Bark light gray, with small, warty ridges. Roots relatively shallow. Twigs reddish-brown, slender, zigzag, with buds whose tips are pressed close to twig. Leaves to 4 by 2 in., sharply, finely toothed, with unequal bases.

Favors hillsides and marshes, but also grown rather commonly as a street tree, particularly in Middle West where it may rival elms in this respect. Ranges through most of United States except eastern New England and Southwest but more common east of North Dakota and Kansas, where its native western boundary lies.

Flowers may have both stamens and pistils, or either, but both are found on same tree. Fruits are cherry-like but smaller than commercial variety, thin-fleshed, about $\frac{1}{4}$ in. in diameter, with a large pit whose surface is rather conspicuously netted. Fruits edible; may not be borne every year, and number varies greatly.

Wood light brown, yellow, heavy but weak, soft, and coarse compared to elms. Does not have durable quality of elms or oaks, therefore of little importance ordinarily though it is sometimes mixed in with elm. A powdery mildew affects leaves, and witches'-broom disease affects branchlets, sometimes seriously.

Greatest use is as a shade tree. Fruits are obviously favored by birds, at least 25 kinds of birds being known to feed on them. Because of this, tree may be useful to those who wish to attract birds. Furthermore, bark is close and fine and trees have a neat appearance along sidewalks.

Soft Hemp, Marijuana
Cannabis sativa

Height to 12 ft., with stalks $\frac{1}{2}$ in. or less in diameter, if grown crowded; or 20 ft. high and 2 in. through, if grown in hills. Leaves opposite near base, and alternate near top, composed of 7-11 dark-green, 2-6-in. roughish leaflets, with notched margins. Stamens and pistils borne in flowers on separate plants.

A close relative of hops, nettles, mulberries, and similar plants. Has been grown since twenty-eighth century B.C., when Emperor Shen Nung taught its cultivation in China. It came to Europe about 1500 B.C., and to America with arrival of earliest pioneers. Grown primarily for cordage. It does best in rich river bottoms.

Seeds sown in March more thickly on rich than on poor soil, 35-50 pounds per acre, usually in drills. Mature, yellow-stemmed, staminate plants more abundant than pistillate, whose stems pale at maturity. Harvesting is possible 4 months after planting. Seed weighs 44 lb. per bushel and has commercial value. Yield of fiber may reach 1 ton to acre.

Hemp fiber 4-8 ft. long; gray if "retted" by dew, white if water-retted; found in flat ribbons made of smaller fibers. Requires soils higher in phosphoric acid than corn, wheat, oats, or cotton. Retting or rotting is done in fields where plants grew, process requiring 2-10 weeks, then stalks are gathered, stacked, and dried.

Used in twines, oakum, and packing; endures friction, heat, and moisture. Dyes blue or violet with an aqueous iodine solution and is high in cellulose. Marijuana, from dried leaves, is smoked as tobacco, and is a dangerous habit-forming drug which stimulates unreasonable and often almost insane activities.

Hop
Humulus lupulus

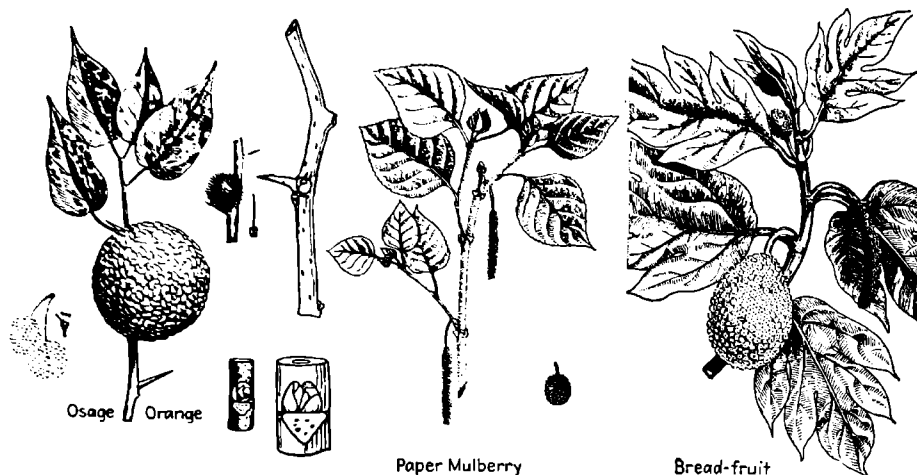
Coarse, climbing vine 20 or more feet long. Roots perennial, sending forth each spring new vines. Stems angular, rough, weak, coarse, dying back each year. Leaves near base of plant, opposite, rough, rather deeply lobed; near upper part, alternate, entire, and less coarse. Stems, roots, or sometimes seeds used in starting new crop.

Under cultivation since time of Roman Empire and grown in Europe since the ninth century. Grown extensively in United States, England, and Germany, formerly being an important crop in New York State, Massachusetts, and Vermont, but now grown more extensively in the Northwest in Oregon and Washington.

Staminate and pistillate flowers on different plants; pistillate develop from cone-like, hairy catkins into short catkins with thin, concave scales at base of each of which there is an aromatic, resinous, bitter substance that contains resin and the drug lupulin. Set 6-7 ft. apart, with poles or trellises near by for vines to climb.

Harvested in late August and early September by cutting vines 1 yd. above ground and picking hop cones, which are then immediately dried in kilns for 12-20 hours over slats at about 120°F. Bleached to yellow by sulfur fumes, then baled in bundles 20 by 22 by 52 in., weighing 180-200 lb., for shipment to market.

Used in medicines, in poultices, as sedative, and for tonic effects but mostly in beer to prevent spoilage by bacterial growth. Chief enemies a red spider, the fungal diseases blue mold and black mold, and a stem borer that was highly destructive to New York plants until skunks were protected by law to destroy borers. Leaves cause dermatitis.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Urticales. Family Urticaceae

Osage Orange, Bois D'Arc
Maclura pomifera

Tree to 60 ft. high. Trunk diameter to 3 ft. Irregularly cylindrical. Bears stiff, spine-like twigs. Bark dark, rough, longitudinally ridged. Twigs stout, greenish to yellow-brown, with buds pressed to twig. Leaves alternate, with entire margins, shining green, smooth, to 5 by 3 in. Juice milky. Usually found in hedges.

Grows on various soils, but mostly on good rich bottom lands. Originally from southern Missouri to northern Texas, but planted extensively and established throughout United States. Grown in hedges because of stiff spines and dense tangle formed. Used in barricades to keep human beings and other animals out.

Staminate and pistillate flowers borne separately, on different trees. Staminate in loose, pistillate in compact clusters. Fruits, hard structures, buried in spongy mass that assumes size and shape of wrinkled, green orange. Seeds weigh 12,140 to the pound, with 50-90% germination; planted 1 in. apart and $\frac{1}{2}$ in. deep, grow year seedlings to 10 in.

Wood hard, stiff, strong; to 48 lb. per cu. ft., bright orange in color, elastic, rough, hardest of our native woods; formerly useful in making bows, axles, woodenware, pulley blocks, paving blocks, and tool handles. In Arkansas, in early nineteenth century, a good Osage bow was worth a horse and blanket. Bark yields a fine, flax-like fiber.

Yellow, orange-yellow, or golden dye or a base for green dyes is extracted from wood and used as substitute for ustic and aniline dyes in arts and industry. Indians used tree for fiber, lye, and bows. Chips of wood boiled in water with cloth give cloth fixed yellow color. Wood 2 times as hard as white oak and $2\frac{1}{2}$ times as strong.

Paper Mulberry
Broussonetia papyrifera

Tree under cultivation, often shrubby, with branches widespread. Twigs moderately rounded, zigzag, sticky, hairy when young; pith, large, round, with green partition at each joint. Buds with striped scales, cone-shaped. Leaf scars rounded and swollen. Leaves like other mulberries, unlobed, mitten-like or 3-lobed, with milky juice. Bark netted.

Native of eastern Asia where 3 species are under cultivation. *B. papyrifera* is hardy in America as far north as New York State; grown mostly there as ornamental. Fruits are eaten by birds. Not partial to any particular soil, doing well on any good average garden soil.

Rather inconspicuous, greenish-white flowers, with pistillate producing a dense, globe-like head of "seeds" surrounded by orange-red pulp. Seeds sown when mature; or wood cuttings made in spring, seasoned in greenhouse in winter; or root cuttings are made. Others are propagated by grafting on desired stock.

Unique in its ability to withstand heat and dust. Makes a favored tree in cities except that those bearing fruits may be untidy in season. Bark peeled and outer bark scraped off with shell. Inner bark then soaked in water and strips pounded together with a mallet over a hard wood log. This may be pounded into "tapa" cloth.

Probably most interesting use is in connection with making of tapa cloth, particularly valuable for clothing and ornaments in the South Pacific area and in eastern Asia. Some of the cloth is paper-thin and stiff, while other cloth may be thick and yet flexible, like leather. Of course, use as an ornamental must not be overlooked.

Breadfruit
Artocarpus communis

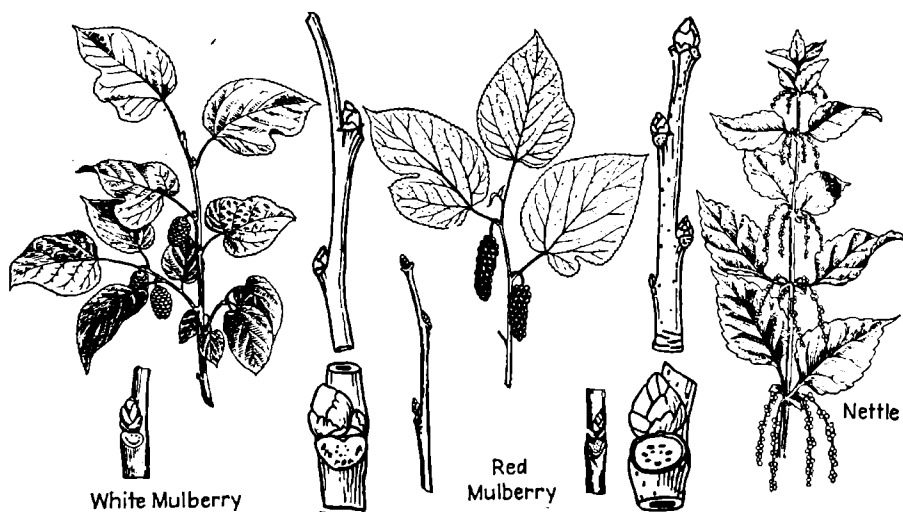
Tree to 60 ft. high, with fragile branches, and often a grotesque form. Juice milky. Leaves from 1-3 ft. long, leathery, rounded or wedge-shaped at base, and, in upper part, with 3-9 long, deep lobes. Leaves usually appear healthy and free from insect or fungus injury. Related jack fruit has leaves entire rather than lobed.

Native of Malayan area, particularly in Polynesia, and widespread in tropics where it has been under cultivation since days of antiquity. Requires a hot, moist climate, with plenty of water but good drainage. Grown in botanical gardens throughout the world where possible.

Staminate flowers in dense, yellow, club-shaped catkin, to 16 in. long. Pistillate in short, compact spike that develops into spiny, globular fruit size of a melon. Some varieties are seedless. An 8-year-old tree in healthy condition may yield to 800 fruits a year, each size of a melon. May be propagated by cutting young shoots.

Carbohydrate content of fruit unusually high. Fruit eaten raw, boiled, baked, roasted, fried, or ground to form a flour used in bread or stored to be used as a paste. Fruits attached to short, thick branches. Natives bake them on hot embers, in pits filled with hot rocks, or sliced and fried.

Probably few plants have a greater yield of useful food for man or beast. Fruits of the related jack fruit may be 2 ft. long instead of 6 in. as in the breadfruit, may weigh to 40 lb. and are borne on the trunk instead of on the lateral branches or twigs. Fruit pulp of breadfruit brownish-yellow.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Urticales. Family Urticaceae

White Mulberry
Morus alba

Tree to 60 ft. high. Trunk to 2 ft. through, normally smaller. Thick-topped, bushy, often escaping cultivation and forming thick copses. Bud scales shorter, more closely pressed to stem than in red mulberry. Buds shorter. Leaves light green, small, smooth above, and sometimes shining and whitish beneath, variously lobed. Bark yellowish, in furrows.

Native of China. Cultivated from earliest times. Introduced into America in Colonial times with thought it might stimulate silk industry. Has become naturalized and independent in East and almost a weed tree near some dwellings. About 100 species of mulberries known through world, many of major importance where they are.

Flowers, in general, similar to those of red mulberry. Fruit smaller, more globular, usually white, though some may be black. Most fruits are sweet. Where 1 in. long, may yield a substantial and a favored food delicacy. Russian mulberry more hardy than normal white and is grafted onto white stock, usually in spring months.

Leaves important product outside the fruits. On the whole, probably most important since they provide basic food for silkworms that provide silk of commerce. In silk-growing countries, leaves are gathered and fed to silkworms. Many horticultural varieties of white mulberry exist including a drooping form, a cut-leaf form, and others.

Uses include food for man, for birds, and for pigs, for which purposes white mulberries are commonly grown near homes; food for silkworms, for which they are grown in extensive plantations; for ornamental purposes, and to a limited extent and probably secondarily, for wood, and possible dyes and fibers.

Red Mulberry
Morus rubra

Tree to 80 ft. high. Trunk diameter to 7 ft.; normally much smaller. Crown round-topped, open. Trunk short. Twigs slender to stout, brown, with swollen leaf scars and pointed egg-shaped buds. Juice milky. Leaves highly variable, from heart-shaped to deeply lobed once or twice, hairy below, and sandpaper-like above; to 5 by 4 in.

On rich bottom lands or moist hillsides. From southern New England south to eastern Texas and Florida, with related Mexican mulberry, *M. microphylla*, extending range into New Mexico and Mexico. Not a common tree in most of its range but planted frequently for various reasons. Found in Appalachians to an elevation of 2,000 ft.

Staminate and pistillate flowers borne on different trees, the staminate in hanging catkins; the pistillate, in hanging spikes. Fruit something like a blackberry, with the hard achene surrounded by juicy, sweet, fleshy red to purple parts. Fruits of Mexican and Persian mulberries almost black, larger, and more spherical.

Wood light, soft, coarse-grained, rather tough, very durable, light orange, with thick, lighter sapwood; useful mostly in boat building, in making cheap wooden boxes, and for light outdoor wooden structures like fences that must withstand weathering. Wood used in making durable wooden pins in shipbuilding.

Tree rarely large enough to yield much lumber, but this has value. Fruits may be eaten by man but are more favored by birds and other forms of wildlife. Some 21 species of birds known to feed on fruit. Commonly planted in bird sanctuaries to attract birds. Squirrels and skunks also eat fruits. Indians made cloth from fiber from bark.

Nettle
Urtica dioica

Height to 1 ft.; related *U. gracilis*, to 10 ft. Covered with bristling, stinging hairs. Leaves on short stalks, less than half the leaf width, with coarsely cut margins and downy undersurface; heart-shaped at base. Stinging nettle of Southern states is *Jatropha stimulosa*, an entirely different plant.

Related to hemp, hops, and mulberries. Naturalized from Europe where it has enjoyed some cultivation for fiber since days of early Egyptians. Common stinging nettle of North ranges through southern Canada and from North Carolina to Missouri.

Flowers clustered in loose formations near the bases of the leaves, greenish, and, in some nettles, staminate or pistillate on one plant or on separate plants. Since the plant will thrive on lands that will support few other crop plants, its culture is relatively simple.

Stinging hairs may cause severe injury. A species in California, *U. holoserica*, is reputed to have a sting sufficiently severe to kill horses, and stings of some Asiatic nettles are reputed to be strong enough to kill human beings. As weeds, plants may be kept in control by cutting twice a year, grubbing with gloved hands, or salting.

In World War I, fiber was cultivated for making fabrics for tents, wagon covers, clothing. Capable of producing a good, strong, white linen. A yellow dye is obtainable from roots. Young shoots boiled make an excellent spinach substitute. In a machine age, it may again become a valuable source of fiber.



India Rubber Plant



Fig



Bastard Toad Flax

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Urticales Family Urticaceae

India-rubber Plant *Ficus elastica*

Tree in tropics reaches height of 100 ft., but in greenhouses rarely exceeds 10 ft. Stems relatively elastic and coarse. Leaves to 12 in. long, with entire margins, coarse, pinnate veins, an abrupt, elongate point at end; dark, shining green above, lighter beneath. Juice conspicuously milky and abundant, when plant is broken.

Native of northern India and the Malayan area but grown widely in the tropics; common potted plants in hotelobbies. Usually grows in forested area, but must have an abundance of water and tropical temperatures. Related to fig that is in the same genus of plants.

Fruits borne in pairs, in axils of leaves, and at first covered by a hooded shield. When ripe, fruit is greenish-yellow and $\frac{1}{2}$ in. long. Plants do not mature until at least 50 years old. Since rubber is inferior, it is not of commercial importance at present and will probably be less so as substitutes develop.

Stems or roots tapped and milk is allowed to drip onto bamboo mats or to accumulate on trunk. Rubber is then scraped off, cleaned, and dried but there is tremendous waste in methods followed by natives and consequently little inducement for them to use this rubber as a source of income. It is known as "Assam rubber" or "India rubber."

Plants are probably more important as house plants. Trees in native lands, with huge buttresses and conspicuous prop roots, provide a unique appearance, characteristically tropical in effect.

Fig *Ficus carica*

Tree to 30 ft. high but relatively weak-looking, with weak stems. May also occur as a shrub in certain climates. Leaves thick, somewhat like a mulberry leaf in shape, with 5 lobes of which 2 basal ones are the smaller. In this species, veins are arranged palmately while those of other species are pinnate.

Native probably of southern Arabia or of Caria in Asia Minor. Spread early through Mediterranean area. Now grown in all tropical and subtropical areas. In America, may be hardy north to Philadelphia. Found as a pot plant almost anywhere. Frequently mentioned in the Bible. Forms include common, caprifigs, Smyrna, and San Pedro figs.

Common figs bear fruits on old wood with second crop of year in axils of leaves. True fruits are borne on short stalks inside fleshy twigs. Common figs need no pollination and have no seeds. Caprifigs pollinated by gall wasp *Blastophaga grossorum*, yield 3 annual crops but have no staminate flowers, so use caprifig pollen.

Must grow on heavy, clayey soils that remain uniformly moist. May survive temperatures down to 10°F., when tops are usually killed unless bent down. May be grown successfully under glass. San Pedro figs of California yield one nonpollinated crop but second must be pollinated to develop. Wasps in figs do not hurt food value.

Figs dried, preserved, canned, or ground and baked to make fig coffee. In addition to food value, have high laxative quality and some medicinal value. California and Texas leading states in fig production; Turkey, Greece, and Italy lead in Old World. Smyrna fig probably most important of all commercial figs. Leaves named in Bible and used in art as cover for nakedness.

Bastard Toadflax *Comandra umbellata*

Perennial herb, with horizontal, underground rootstock and flowering stems that reach a height of 18 in., much-branched, well-supplied with leaves. Leaves oblong, thin, pale green, darker above than below, to $1\frac{1}{2}$ in. long, with prominent, pale midrib. Plant smooth and seems anemic though it obviously is not.

Found on dry grounds among growing trees and shrubs or near them. Ranges from central Maine to Wisconsin and south to Georgia. Often found in rather dense stands of the herbaceous stems so that if one plant is found many are likely to be near by, these probably or possibly arising from common rootstock.

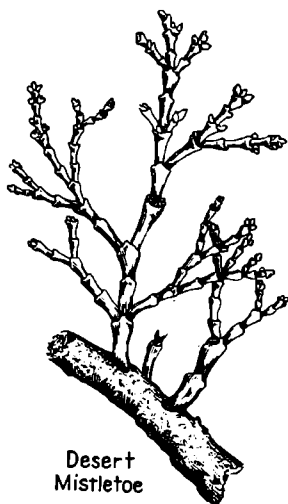
Flowers pale green to white, bearing both stamens and pistils, in clusters that seem to arise from a common point near top of herbaceous stems. Calyx tube attached to dry, urn-shaped fruit. Flowering period May and June. Fruit nut-like, maturing in midsummer after which plant dies back for season.

Parasitic on roots of various trees and shrubs. Since by this method it gets much of its nourishment, it is not necessary that it develop robust food-producing leaves as is case with plants with more independent habits. Doubtful if plant ever does any serious damage to its hosts, though apparently this has not been studied exhaustively.

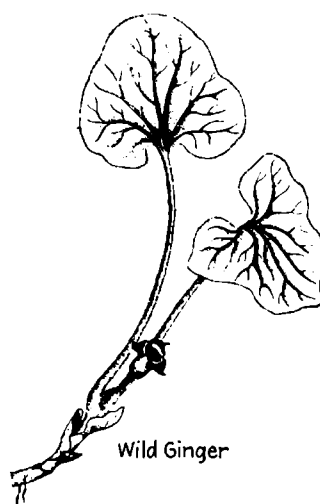
Interesting because of its parasitic habit but not of commercial importance. There are many species in this genus that are independent.



Mistletoe



Desert
Mistletoe



Wild Ginger

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Santalales Family Doranthaceae

Order Aristolochiales Family Aristolochiaceae

American Mistletoe *Phoradendron flavescens*

Shrubby, rubbery, greenish-barked plant that grows from some part of a tree as a parasite. Leaves pale green, easily broken, rather thick, oval, smooth, to about 1 in. long, somewhat succulent. Whole plant may form a sort of loose globe as big around as a barrel, with branchlets spreading in all directions.

About 100 species, of which this one is found on many trees that shed their leaves. Ranges from New Jersey and southern Indiana south to Florida and Texas; also in California. Not cultivated although it has a market value with florists. All mistletoes are American. Most are tropical with but few found in Western states.

Flowers either staminate or pistillate, on different plants. Staminate flowers in small, catkin-like spikes. Pistillate flowers in short spikes, produce pulpy, pale green to white, 1-seeded berries, about $\frac{1}{4}$ in. in diameter. Berries eaten by birds and seeds planted by them in their droppings at some remote point.

Plants harvested and stored in cool temperatures previous to Christmas season, when they are sold to flower dealers. Once believed to have medicinal properties and those growing on oaks to have magic powers. Make their own sugar and starch with their own chlorophyll but draw on hosts for water and mineral supplies.

Mistletoe may injure many shade and timber trees. Dwarf mistletoe attacks cone bearers, while this species attacks deciduous forms. A hook on a pole or rope is used in collecting mistletoe commercially. Fruits reported as having been fatal to children but not to pigs. License to kiss one under a mistletoe at Christmas has its possibilities and penalties.

1. Desert Mistletoe *Phoradendron californicum*

2. Tufted Mistletoe *P. densum*

3. Juniper Mistletoe *P. ligatum*

4. Colorado River Mistletoe *P. coloradense*

Hangs in great, loose balls or festoons from tops of trees or shrubs or erect in tufts, with rubbery greenish stems and opposite leaves. Leaves of (1), small; (2), larger and oval; (3), scale-like and much narrowed at base; (4), thick, larger, and with no evident veins. All seem to be so designed that they may conserve water loss.

Grow as parasites (1) on ironwood, mesquite, palo verde in California and Arizona deserts, (2) on California juniper from southern California to Oregon, (3) on desert and mountain junipers, (4) on mesquites along Colorado River. Another mistletoe of western deserts is variety of eastern form that is conspicuous on cottonwoods along Mohave River (large-leaved).

Staminate flowers sunken in joints or spikes, smell in evening like apple blossoms. Pistillate in separate flowers, developing by November into berry-like fruits that are coral-pink in (1), straw-colored in (2). Berries eaten by birds as source of food and water from November to April and seeds are in droppings. Seedlings attack plants on which bird droppings are left.

Birds known to carry seeds of desert mistletoe include phainopeplas, robins, thrashers, desert quail, bluebirds, and others. Some plants like beefwood are able to resist attack of mistletoe by exuding a gum at point of attack.

Birds eat some fruits, many of which are usable as food by man in areas and at times when food might not otherwise be available. Plants obviously harm some forage trees in desert areas but while fruits of eastern mistletoe have been known to be fatal to children, Western Indians used to boil stems of desert mistletoe with fruits and eat them.

Wild Ginger *Asarum canadense*

Height to 6 in., growing from a horizontal, perennial, partly buried rootstock that shows growth and leaf scars conspicuously and branches and persists for years. Leaves about 2 to a plant, kidney-shaped, thin, long-stalked, 6 or more inches long, with a deep sinus at base of expanded part, with conspicuous veins but not mottled.

Found in rich woodlands where there is moist soil in spring, from New Brunswick to Manitoba, south to North Carolina, Missouri, and Kansas but most abundant in northern part of range. In prairie states, a more pointed-leaved variety is common form. On Pacific Coast, an evergreen species *A. caudatum* takes place of *A. canadense*.

Flowers partly buried in duff of forest floor; chocolate brown, with globular base on end of slender stalk and expanded at mouth by 3 sepal lobes that spread 1 in. or more. Flowers April and May in North. Pollination by small flies, possibly fungus gnats and flesh flies. Fruit a fleshy capsule that bursts to free many seeds.

Plant obviously cannot survive in long direct sunlight and lives most of its year of activity in the spring and early summer months. Rootstock not offensive to taste. Flowers and leaves relatively attractive in a wild garden and easily propagated.

Element in rootstock is mildly purgative and is used to some limited extent in medicine as an irritant. Chippewa Indians called it "namepin" or "sturgeon plant" and used it as an emergency food or as a medicine in case of indigestion. It does not seem to have had wide use by other Indians.



Curled Dock



Smooth Dock



Broad-leaved Dock

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polygonales. Family Polygonaceae

Curled Dock, Yellow Dock

Rumex crispus

Height above ground, to 3 ft., erect, well-branched, slender, tough, smooth, bearing fruit clusters at branch bases. Leaves somewhat narrowly oblong, with conspicuously wavy, crisped margins that are smooth and entire, alternate, rather thick but not succulent or rough. Roots large, red or yellow, with expanded taproot to 1 ft. long and 1 in. thick. Perennial.

Found in open dry spaces such as meadows, roadsides, gardens, lawns, fields, pastures, particularly where some neglect is evident. Ranges throughout United States and southern Canada. Naturalized from Europe whence it has spread to other parts of world possibly through being a common impurity of commercial seeds.

Flowers perfect, with 6 sepals, the outer 3 expanding in fruit, and inner making a thin envelope around 3-sided brown fruit. Flowers individually inconspicuous. Stamens 6 to each flower, with one 1-seeded fruit. Fruits more pointed at free end, polished brown, long-lived under normal conditions. Pollination by wind.

Late summer rosettes may become large in winter, are hardy. Control by late ploughing and frequent cultivation. Leaves bear maggot of leaf miner the fly *Pegomyia calypttrata*, support, the moth *Papaipema nitela*, a pest of corn, tomatoes, and potatoes, the copper butterfly *Chrysophanus thoe*, and a brilliant beetle.

Powdered root used medicinally if harvested just after fruits mature. Fruits eaten by many winter birds. In spring and fall, rosette leaves may be cooked as greens. Commonly cooked with other greens and improved if bacon or salt pork is added. Fruits eaten by 21 species of ducks.

Smooth Dock, Pale Dock

Rumex alissimus

Height to 6 ft. or over, rather coarse, smooth, and tough. Leaves sharply pointed at either end, and broadest just below middle, smooth, somewhat shining, with rather obscure veins, and with lower leaves much larger and broader than the higher. Forms a vigorous rosette in spring and fall. Perennial.

Found on rich, loose soil such as is found in river bottoms or in some good gardens, from Connecticut to Nebraska, south through United States to its native Mexico. Through much of Middle West, it is common dock of fields and pastures, much as curled dock is common in East.

Flowers borne on parts of stem above that are almost leafless, in whorls on ends of short drooping stems, these stems being shorter than calyx that expands to enclose small triangular, brown, pointed fruit that looks something like a small brown buckwheat fruit. Fruit paler than fruits of most related docks.

Shallow, horizontal roots running just beneath surface of ground make it possible for this plant to occupy considerable territory if it is kept unchecked. Roots cannot survive considerable exposure to sun. Common control practice is merely that of shallow cultivation. Plants may be pulled by hand if soil is reasonably moist.

Like most docks, this is a weed. While it is not listed in books describing common wild plants useful as food, raw leaves are not distasteful when young and would in all probability make good greens if cooked like spinach or similar plants.

Broad-leaved Dock

Rumex obtusifolius

Height to 4 ft., with stout, erect stem, unbranched or with a few branches, grooved, dark-green. Lower leaves to 14 in. long, with long petioles, with rounded base and blunt or pointed tip. Upper leaves smaller, with less tendency to have a heart-shaped base and with petiole proportionately shorter. Root stout and deep. Perennial.

Naturalized from Europe, well-established through North America in southern Canada and throughout United States. Varies greatly in abundance in different localities. In Middle West not the common dock, being there replaced by smooth dock *R. alissimus*. In East, common large dock is probably *R. crispus*.

Flowers borne in loose whorls at or near tip of stem or at base of upper leaves, on slender drooping stems. Calyx wings pointed below middle, rather large and conspicuous, brown, but only one sepal bears a grain or fruit. Fruit $\frac{3}{8}$ in. long, 3-angled, glossy brown, virile, with angles standing out conspicuously because of margins.

Many insects find food and shelter on this plant, among them a fly that builds a huge blotch mine, one leaf often being badly infested by many such flies. Root used medicinally but of doubtful value. Tops browsed by deer. Fruits eaten by waterfowl. If plants are cut before flowering in June, may be kept from multiplying unduly.

Common seed impurity of clovers, which should not be sown with it. Plant can be controlled by avoiding introduction by using clean seed, by heavy cultivation, by using overrun plow, by improving drainage, and by hand pulling of yellow, spindle-shaped root, which comes relatively easily by twisting it from moist ground.



Sheep Sorrel



Knotweed



Water Smartweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polygonales. Family Polygonaceae

Sheep, Garden, Field Sorrel
Rumex acetosella

Height to 1 ft., erect, simple, smooth slightly grooved, slender, tough, green or brown, arising from creeping, branching, yellow, tough, fibrous rootstock. Leaves to 5 in. long, usually much shorter, to 1 in. wide, shaped like an arrowhead; basal ones, long-stalked; grooved along veins, smooth, sour. Perennial or annual.

Common on fields and roadsides, particularly on acid soils or in sour pockets in soil. Grows well on ground where there is little water as is case in many waste places. Ranges throughout North America except in far north. Established apparently from Europe either as an impurity of commercial seeds or in hay wastes.

Flowers in small, erect clusters, Staminate yellow, pistillate red. Borne on separate plants. Pollination wind or insects. Flowering time May through September. Fruits 1-seeded, small, brown, obscurely 3-angled, usually enclosed in semipersistent calyx. Seeds may be shaken from plant. Cycle from seed to seed, a few months.

Considered a superficial indicator of presence of acid soil. Helps serve as a soil anchor by growing in soil that would not support many other pasture plants. Seems able to survive drought well and provides some forage in dry times. Control by cultivation of fields, exposing roots to drying, by enriching soil with fertilizer, or by liming.

New spring or autumn growth yields leaves good raw in salads, or cooked, served with cream sauce or in cream soups providing tart stimulant to flat foods. Plant may be crowded out by encouragement of rival plants such as grasses or clovers. Human beings may get dermatitis from leaves. Animals with low calcium diet may be poisoned by eating leaves.

Knotweed, Knotgrass
Polygonum aviculare

Prostrate, but with stems to 1 yd. long, branching, faintly ridged, spreading, with underground parts white, woody, fibrous, with deeply boring taproot. Leaves bluish-green, to 1 in. long, elliptical, often with grayish bloom, with short stalks or stalkless, relatively dry and tough, with a membranous, thin, gray scale at base. Annual.

Common on bare dry spots along paths, driveways, and barnyards. Native of Europe, Asia, and America. Widely established in these continents, mostly where man lives. Sometimes found in poor lawns where soil has been too compacted for success of clovers and grasses. Grows commonly in cracks in sidewalks and pavements.

Flowers small, greenish-white, with pinkish margins, borne in axils of leaves; in flower, from June to October in North. Probably self-pollinated. Fruits 1-seeded, small, dry, dull light brown, sharp-pointed, 3-angled, finely ridged, fall from plants. Seedlings grass-like, first leaves being narrow.

Thought to be troublesome to sheep. Often harbors a white mildew that gives plant a dusty appearance. Helps cover dry, unoccupied ground. To some extent, may hold soil temperature down and control water loss through evaporation. May also anchor soil that might be eroded. A few months, from seed to seed. Seeds have good vitality.

Controlled by hand pulling, hoeing, spraying with usual salt spray used in weed control, or by loosening soil so that other plants may thrive. Cannot stand such competition. Seeds commonly found as impurities of many kinds of commercial seeds; listed as food of 10 duck species.

Water Smartweed
Polygonum amphibium

Stems to 20 in. long, branched or unbranched, floating on or just below water surface, or sprawling in soft ooze at edges of ponds. Leaves oblong to elliptic, rather coarse, petioled, to 4 in. long, rounded or narrowed at base, and sometimes hairy. Sheaths at leaf bases longer than distance between the joints, so stem is largely hidden.

Found in fresh water, mildly alkaline, or mildly acid pools, streams, marshy spots. From Quebec to Alaska, south to New Jersey, Kentucky, Colorado, and California. In Adirondacks, found to an elevation of 2,000 ft. Found also in Europe in similar situations. A number of varieties are found in America and Eurasia, with highly variable growth habits.

Flowers in compact, flame-shaped clusters at tip of stem, held erect. Since calyx is rose-red, an aggregation of plants may give a pink effect at a distance. Stamens, 5. Fruit 1 to a flower, 1-seeded, orbicular to oblong, about $\frac{3}{4}$ in. long, smooth, shining or granular on surface. Reproduction by rootstock or seed. Seeds germinate 26% in 45 days.

Plant serves as shelter and food source for many invertebrate, fresh-water animals that are themselves food for fish. Mass of plants may serve to anchor soil from wave wash at edge of ooze-bottomed ponds. Since plants may sometimes be found over extensive areas in almost a pure stand, they add no little beauty to a spot when they are in full bloom.

Plants may clog shallow regions from which waters may leave a reservoir. Do not help keep muddy beaches clean of vegetation. Seeds or fruits in diet of shore birds and 15 species of ducks. Seeds stored at near-freezing temperatures in moist, ground peat moss. Seeds dry 5 months are dead. Ruptured seeds germinate about 85%.



Pink
Smartweed



Lady's Thumb
Smartweed



Morning Glory Smartweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polygonales. Family Polygonaceae

Pink Smartweed *Polygonum lapathifolium*

Height to 7 ft. under ideal conditions, but normally much shorter, smooth, branching, usually swollen at joints, with sheathing scales at bases of leaves. Leaves to 10 in. long, pointed at each end, with base being blunter; margins entire, netted-veined, with midrib rather conspicuous. Annual.

Found in waste places throughout most of temperate America. May have been introduced from Europe where it is found in great abundance. Also found in Asia. Sometimes becomes a weed particularly in low, moist, fresh, or lightly alkaline situations where average crop plants are not likely to offer serious competition.

Flowers in drooping narrow clusters, to 1 in. long, rather compactly arranged. Calyx, pinkish, white, or greenish, and 5 parts. Stamens, 6. Fruit a 1-seeded achene, one to a flower about .1 in. long, flattened, dark-brown, with surface that is finely grained or glossy, and with calyx persisting about it.

Wet lands almost essential to success of this plant, so it is not surprising to find it most abundant in newly drained areas, on flood lands, or along water courses. On higher, drier lands, it is never a serious weed. To layman, it looks like a tall, light-flowered lady's thumb smartweed without dark spots on leaves.

Usually kept in control by cultivation of land or by improving drainage. Fruits provide some food for birds of slough areas including ducks (17 species) and land game birds. Plants might conceivably serve a role in anchoring soil regions exposed to recurrent floods.

Lady's Thumb Smartweed *Polygonum persicaria*

Height to about 2 ft., nodding at tips, smooth, with sheaths at bases of leaves, bristly with hairs. Leaves pointed at each end, roughish, to 6 in. long, without petioles or with very short ones; usually with a dark, heart-shaped V on leaf near center; margins entire or slightly irregular. Annual.

Common in neglected garden, in waste places usually where soil is looser than that favored by knotweed. Naturalized from Europe, widely established. In America, found from coast to coast but less common to north, being frequently most abundant in fields after a grain crop has been harvested.

Flowers in drooping, usually terminal flower clusters resembling compact spikes; many spring from axils of upper leaves. Calyx pink or purple. Stamens, usually 6. Fruit a 1-seeded achene like a broad, somewhat lens-shaped egg, or sometimes angular, to almost $\frac{1}{8}$ in. long, smooth, shining, and easily shed from cluster. Flowers June to October.

Commonly associated with grains and cultivated lands. Black mark on leaf has some legends, indicating that it is finger mark of a lady, hence name lady's thumb. Reputed to have medicinal value in heart troubles because of heart-shaped "sign" on leaves. Of course, none of these ideas has merit in fact.

Common names include lover's pride, heartsease, redweed, pinkweed, common persicaria, redshank, willowweed, blackheart, spotted knotweed, significance of each of which is evident. Easily controlled by cultivation, particularly if cut before flowers have set fruits. Seeds found as seed impurities in commercial seed and eaten by wildfowl and upland game birds.

Morning-glory Smartweed *Polygonum convolvulus*

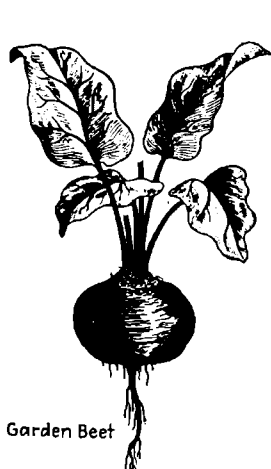
Twining, slender stems reaching to 1 yd. and climbing on other plants or sprawling on ground. Stems roughish, smooth at joints. Leaves to 3 in. long, heart-shaped, pointed at tip, with slender petioles, slightly hairy, usually a rich green. Root system not extensive, as plant is annual.

Common in waste and cultivated areas throughout most of North America except extreme north and in West Indies. Naturalized from Europe and sometimes locally a troublesome weed. Probably brought to America as an impurity of commercial seeds or in hay trash.

Flowers greenish, hanging in loose clusters from axils of the alternate leaves. Calyx 5-parted, closely covering the 1-seeded fruit that is dull black, with a wrinkled surface, obscurely or obviously 3-sided, pointed at either end and about $\frac{1}{8}$ in. long.

While this behaves somewhat like some morning-glories, it does not have typical morning-glory flower or perennial underground parts like those of the morning glory. Leaves and twining habit provide resemblance that is reflected in the common name. Flowers July to October. Should not be allowed to go to seed.

Control by hand picking, cultivation, and repeated harrowing. Seed common impurity in seeds of grains, particularly of oats and wheat. Vitality of seed probably less than 3 years, so a short rotation including hay for 2 years should check it. Seeds germinate late in spring and seedlings about 3 in. high should be destroyed; eaten by wildfowl.



Garden Beet



Sugar Beet



Rhubarb

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polygonales. Family Polygonaceae

Garden Beet
Beta vulgaris

Stem produced in second year, to 4 ft. high, bearing many small flowers. Leaves of the flowering stem, narrow and linear. Basal leaves of different shapes, but usually smooth, commonly green, with reddish veins, usually clustered close to ground. Thickened root may, by finer roots, penetrate 6 ft. of soil. Biennial or annual.

Probably a native of Europe; has been known as a cultivated plant since third century. Sugar beets and mangels are common forms of beets. Swiss chard another variety. Some beets grown for ornament; some, for use of leaves as greens. In Swiss chard, midrib of leaves is greatly enlarged.

Flowers numerous, in open-topped, branching arrangement, greenish, with 5-parted calyx, 5 stamens, a sunken ovary that bears 3 stigmas. Usually, 2 or more flowers become grown together to form a "fruit" in which true seeds are developed. Each seed enclosed in a thickened calyx. Seeds may retain their ability to germinate for 5-6 years.

Seeds planted in boxes for early greens to be transplanted in garden in rows 24-30 in. apart; sown in drills in fields, require 4-6 lb. to acre; produced when plants are subjected to a temperature of 40-50°F for 15 days or longer. Roots may expand at or above surface. Hand cultivation expensive, possible only where market high and labor cheap.

Root diameter of 1½ in. are bunched and sold; larger roots stored through winter at 32°F. or in outdoor pits or banks such as were used in earlier days. Also raised for canning. 1937 crop in United States was about 19,150 acres, with a cash value of \$1,454,000, these figures referring to beets grown for canning and shipment to distant markets.

Sugar Beet
Beta vulgaris

Biennial plant, with leaves arising to height of 2 ft. from huge vertical root that averages about 1 ft. long and to 3-4 in. wide at top, tapering to point below. Leaves crinkled, curved much like leaves of spinach, with definite forage value in addition to value gained from root culture.

Probably a native of Europe. Pure sugar first extracted in Germany in 1747. First sugar-beet factory in Silesia in 1799. First profitable factory in United States in California in 1879, with many now established particularly through California, Utah, Colorado, and Michigan areas, with some north into Ontario.

Ordinarily sugar beets are harvested before seeds mature. Seed borne in numerous flowers that are clustered in an open, branching arrangement, but with some flowers grown together to form what seems to be a single fruit. Germination power retained to 5 years. Seed-bearing plants chosen by testing sugar content of different roots and saving best.

Profitable sugar content expected in regions with average temperature of 70°F. through June, July, and August. High temperatures cause low sugar yield and low temperatures cause improper ripening and low content. Formerly, yield was about 8-10%. Now commercial yields of to 18% are expected. Rainfall, May to September, should average 4 in. a month.

Processing of sugar is done on ground during season of 60-120 days out of year. Since sugar is produced in competition with sugar grown in foreign areas such as Cuba, maintaining market with profit involves many labor and commercial difficulties. Politics has greatly influenced success of industry. Seed required, 5-6 lb. per acre.

Rhubarb
Rheum rhabarbarum

Height to 6 ft., with conspicuous joints, hollow-stemmed. Leaves to 2 or more ft. long, with broad, coarse, thick blades; petioles, sometimes 1½ ft. long, and to over 1 in. thick, succulent; when young, break crisply. Roots large, dark-brown, branching from a crown. Perennial. Popular variety, Victoria.

Native of Asia, but grown for home and market widely over the world. Most noncity homes have a corner in garden with one or more of these plants. Does best in a soil that has been deeply plowed, is light and well-filled with humus. Normally, such a plant requires little attention.

Flowers numerous, small, greenish-white clusters borne in a rather, loose open formation at top of stem that arises after leaves reach prime. 3 years, from seed to seed. Roots divided every 4-5 years and set in rows 4-6 ft. apart, roots being 1 yd. apart; buried 3-4 in.

During third season after setting new roots, leaves may be cut for 4-5 weeks but after that may be cut for 2 months. Leaf-spot disease affects market value of leaves. Crown rot affects roots; controlled by dusting leaves and treating roots with corrosive sublimate. Relatively free from insect injury. Weeds should be kept down. Mulch desirable.

Petioles harvested, skinned, and eaten raw in salads, or more commonly sliced, stewed, and used as a sauce or in pies tasting not unlike a sour apple pie. Nutritive value is probably essentially in vitamin B though cooking may not preserve this value. Crushed and sweetened makes a delicious drink.



Buck Wheat



Spinach



Lamb's
Quarters
Pigweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polygonales
Family Polygonaceae

Order Chenopodiales
Family Chenopodiaceae

Buckwheat

Eriogonum fasciculatum

Height to 3 ft., erect, strongly grooved when old; with stems smooth except at joints. Leaves to 3 in. long, shaped like a triangle but borne on rather long petioles, with conspicuous veins, with apex somewhat drawn out, with bases of leaves where attached to stem enclosed in a rather brittle, small but conspicuous bract. Annual.

Escaped in waste places and persisting in fields where it has been cultivated. Known from practically all inhabited parts of United States and in southern Canada. Also found in West Indies, Europe, of which it is native, and in eastern Asia where it is grown rather extensively on poorer soils.

Flowers borne in clusters from stalks arising from bases of upper leaves. Calyx in 5 whitish parts, with about 8 stamens, with 8 nectar-bearing yellow lands placed between stamens. Fruit reduces a single, triangular, gray thence, on lower portion of which persists some of calyx, to about $\frac{1}{2}$ in. long.

Raised as emergency crop where other crops have failed and where some forage is desired. Also raised along edges of fields as food for game birds. Honey made by bees visiting these flowers may be dark and strong but abundant. Men like pancakes made from buckwheat flour.

May cause photosensitization of domestic animals if animal is white or has un-pigmented skin, if enough is eaten or animal is later exposed to bright sunlight. Does not affect animals fed and kept in stalls. Symptoms inflamed eyes, ears, and face, with itching that may appear weeks after feeding. Some human beings get dermatitis from flour from leaves.

Spinach

Spinacia oleracea

Height to 2 ft., stem being usually unbranched or only slightly so. Leaves smooth, green, large, those produced in cool weather forming a dense crown. Leaves of flowering stalk narrow, oblong, variable. Flowering stalk may branch from axils of leaves. Flowers borne on both main stalk and branches. Annual.

Native of southwestern Asia, with 1 of the 4 species being widely cultivated. In United States, California holds a leading position in growing spinach. Grown commercially for shipping in 14 states and for local consumption in most states. In 1937, Texas had 50,000 acres of spinach; California, 16,720; Virginia, 6,800; and New Jersey, 3,000.

Flowers usually either staminate or pistillate, with some bearing both stamens and pistils. Stamen-bearing flowers usually found on leafless spikes; pistil bearers in leaf axils. Fruits enclosed in structures bearing 2-4 spines, small, generally inconspicuous. Considerable variation in different strains cultivated.

When grown in rows, seeding requires 4-6 lb. per acre; broadcast, 8-10 lb. Rows 10-24 in. apart, and plants thinned to 5 in. For Texas, winter crop seed is sown September to January; for fall crop in North in late summer. Diseases include spinach blight or yellows, downy mildew, leaf-spot; checked by good fertilizer and care.

Grown for marketing and for manufacture, importance being reflected in acreage of 13,680 in 1919 and 106,340 in 1937, about $\frac{1}{3}$ being grown in later years for manufacture. Importance of salts and vitamins it adds to average diet has been emphasized. "Popeye" has helped popularize it with many children. In shipping from California to East, usually requires about $\frac{3}{4}$ its weight in ice.

Lamb's-quarters Pigweed

Chenopodium album

Height to 3 ft., well-branched, stems bearing clusters of fruits that persist through winter. Has smooth but powdery appearance, with stems often ridged and grooved. Leaves alternate, to 4 in. long, somewhat diamond-shaped, with entire or shallowly lobed margins; petioles sometimes as long as blades. Root, a deep taproot. Annual.

Waste places and gardens or wherever there is good sunlight, loose soil, and some water. Found throughout United States and Canada; native of Europe and Asia, whence it was probably introduced early in commercial seeds or in hay trash. Not found in extreme north in Canada but wherever man maintains some form of plant agriculture.

Flowers small, greenish in compact clusters close to tips of stems or branches. Calyx 5-parted, more or less enveloping fruit when mature and persistent. Petals inconspicuous. Stamens, 5. Pollination of some species by wind; of others, by insects; commonly, by self. One fruit per flower; one seed per fruit, plump, lens-shaped, highly variable.

Rapidly growing weed easily adapting itself to varying conditions. Occupies land growing common crops. Control effected by cultivation, by cutting before flowering takes place. Host for a leaf mining fly *Pegomya hyoscyami*, the skipper butterfly caterpillar *Pholisora caudana*, and many aphids and leaf hoppers, some carrying virus plant diseases.

Useful as a winter lunch counter for many winter birds and as a lifesaver for some winter game birds. Plant not affected by most sprays such as those that destroy mustards. Young growths 6-10 in. high are eaten raw by man or are cooked like spinach and eaten. Fruits eaten raw, or dried, ground, cooked as mush, taste somewhat like buckwheat.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Chenopodiales. Family Chenopodiaceae

Summer Cypress, Belvedere
Kochia trichophylla

Height to 5 ft., much-branched, forming a usually symmetric, rather compact, globose, pyramidal, or egg-shaped unit. Branches slender, striate, close to main stem, bearing slender leaves that are to 4 in. long, usually a pale, fresh green in summer, turning in late summer or fall to a brilliant red in some forms.

Probably native of China, but introduced in gardens in many parts of world. Some 40 species of *Kochia* in the world including white sage *K. vestita* of our Western salt deserts and *scoparia*, a garden ornamental, native of central Europe. Summer cypress does well in areas that in late summer are relatively dry, such as along paths and roadsides.

Flowers in ball-like clusters, some fertile and others not, those on lateral branches eventually bearing fruits and seeds that are small and enclosed in persistent calyx. Seeds planted indoors in April; seedlings set out in May; or seeds sown outdoors in May in North. Should be thinned so that one plant will be 3 ft. from next.

Summer cypress useful in gardens since it continues to stand and be attractive in fall after other plants have been killed by frost, and because of its fresh greenness and regular shape early in season. White sage of desert can survive high salt content in soil at 1 ft. depth, and if upper 18 in. is salt-free, plants may do well.

Deserts with white sage may not be expected to yield crops without irrigation but may be worked profitably if irrigation is available to remove undesired alkali. Summer cypress may seed itself on soils that are suitable but may not be easily established in a location too wet or too hard.

Spiny Hop Sage
Grayia spinosa

Shrub reaching a height of 3 ft., with a mealy appearance. Twigs sharp at tips, forming rather formidable spines when mature. Whole plant has a unique, green appearance different from associated plants. Leaves somewhat fleshy, with gray tips but with a tendency to assume a pinkish tint with age.

Common on mesas and flats in desert areas about Mohave Desert at elevations of 2,500-7,500 ft., to eastern Washington, Wyoming, and Colorado and in Whitewater Canyon on Colorado desert area. Common locally but with a rather spotty distribution probably because of its physiologic needs.

Flowers small and inconspicuous, as are most of those in this family, but develop into rather attractive fruits that are sometimes a brilliant rose-purple because of surrounding winged calyx which of course persists. Not all plants bear fruits. One fruit to one flower, but flowers and fruits are crowded.

When plants or year's growth are young, soft green herbage provides a welcome and abundant forage on which both sheep and cattle feed readily and on which they fatten well. Later in season, when fruits are ripe, these animals feed on them also with good results. Sometimes fruit harvest is surprisingly abundant.

Values as suggested above, largely as a basis of food for domestic animals living in an area in which forage plants are famous for their absence. Conceivable that plants of this type might have been of lifesaving importance to early settlers who found themselves stranded with their stock in desert-like areas.

Shadscale
Atriplex confertifolia

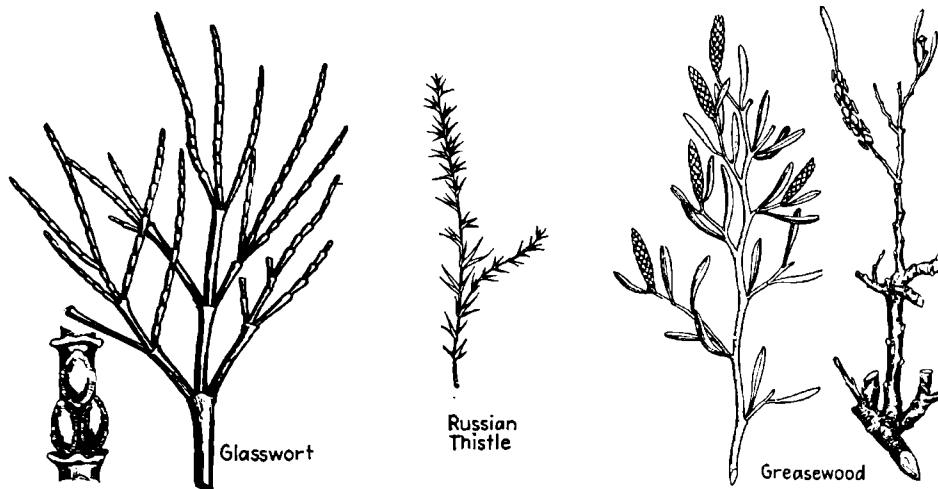
Height to 4 ft., a woody, spiny, much-branched shrub that forms a great, globe-like, open plant, with some of its branches well-supplied with egg-shaped entire leaves that are not persistent and with some of the branches naked or nearly so. Root deep and strong, going down to 3 ft. or more, depending in part probably on the demands of the situation.

In salt marshes and on exposed limestone, and relatively common in such situations from Idaho to California and east into northern Arizona except in the Colorado desert and of course only where the soil conditions and rainfall are suitable. It is one of the plants that helps define the appearance of the deserts within its range.

Flowers pistillate or staminate, and relatively inconspicuously hidden in the axils of the leaves but more particularly near the ends of the branches. Fruits enclosed in rounded, wedge-shaped, thick calyx bracts; 1-seeded, and when mature, are treed and blown from place to place by wind. Following shedding of leaves, twigs become coarse spines.

Provides some index to nature of soil, as its presence indicates a probable gravelly soil to a depth of 2-3 ft. that dries in summer and may become salty at a depth of 1 ft. or more. Without irrigation, such lands might possibly produce crops; with irrigation and the removal of alkali, it surely can.

Provides some early-season forage before the leaves are shed and before the twigs have developed the offensive and decidedly protective spines. The fact that cattle can survive in shadscale country at all is surprising to those accustomed to seeing them in more favorable surroundings. Shadscale is poisonous if selenium is in soil; causes blind staggers in cattle that eat it.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Chenopodiales. Family Chenopodiaceae

Glasswort
Sarcobatus vermiculatus

Height to 2 ft., with stem usually erect, much-branched, with branches slender, spreading, upright or rising at tips, with joints 2-4 times as long as they are thick. Leaves scale-like, blunt, under .1 in. long, much wider than long. Roots variable, depending largely on nature of subsoil; usually shallow-rooted. Annual.

In salt or alkaline marshes, from Antislip Island to Georgia, to Manitoba, British Columbia, south through Utah and Kansas but only where there is salt. Found also in Europe and in Asia. Because of high salt requirements, presence of plant is usually associated with lands that are waste from an agricultural viewpoint. Best on tide flats flooded once in 2-15 days.

Flowering spikes are about 1-3 in. long at slender, only about 1/4 in. in diameter. In spike, 3 flowers at each joint, middle one being about twice as high as its neighbors, reaching nearly to top of joint. Stamens 2 to a flower. Seed compressed, enclosed in a spongy, winged calyx. Flowers from July through September.

In a depth of 4 in., soils that support glasswort may have a salt concentration of 2.3% of dry weight of soil as contrasted with 1.8% for sea blite *Dondia plessa* and 1% for *Atriplex*. This indicates an abnormally high resistance to the nature of salt as it affects most plants.

In general, soils that will support glasswort must be considered incapable of producing crops either with or without irrigation. Plants often turn vivid red in fall, giving rise to name marsh empire. Other names include saltwort, pickle plant, English sea grass, duckens' toes, frog grass, crab grass. 1,000 seed found in one pintail.

Russian Thistle
Salsola kali

Height to 3 ft., with many branching stems extending to form a huge, loose, open globe, sometimes 4 ft. or even more through; breaking loose to form a tumbleweed. Leaves alternate, stiff, short, prickly-tipped about 1/2 in. long, with shorter, sharp-pointed bracts at bases of older leaves. Has general appearance of thistle.

Dry deserts, fields, and waste places, along railroad embankments and in meadows. Native of Asia but widely established in North America from Manitoba to California and east through New York State. In some areas, like western Dakotas in bad years, it may be most conspicuous of all plants as it is a last survivor of drought conditions.

Flowers in axils of leaves, small, greenish, whitish, red, or pink, with 5-parted calyx which encloses mature fruit, leaving papery margin that helps in wind distribution. Fruits reddish, top-shaped, long-lived, and most abundant. Seedlings grass-like; may give impression that a good grass crop is developing.

Green in midsummer when other desert plants are brown. Flowers in July, and may be eaten by cattle. Fruits mature by September, but by then plants are too tough to be eaten. A single plant may produce over 100,000 fruits and a single plant on a railway car track may plant miles of roadbed.

In depression years, plants are cut green, salted, watered, and fed to cattle, but normally they are destroyed where possible by plowing, cultivating, or burning. Ash has been used as an impure carbonate of soda under name barilla. Ample able to take care of itself under conditions trying for most plants.

Greasewood
Sarcobatus vermiculatus

Low, branching, but conspicuous shrub, with somewhat spiny branchlets and bright green, rather thick leaves whose unbroken margins make them look somewhat like branchlets. Rather like gray shadscale. Roots penetrate to depth of 6-7 ft.; much larger than might seem necessary for such a small plant. Stem to 3 in. through.

Found in arid deserts, but usually where there is usable water within reach of long roots. Widely distributed, most conspicuous in deserts of Utah, Nevada, and California. Favors regions of clay flats or where there are salty areas and may form rather pure stands in good conditions.

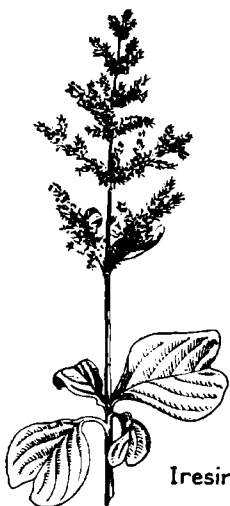
Flowers rather inconspicuously clustered at base of some of leaves; staminate, in cylindric spikes to 1 in. long; pistillate, producing one hard fruit with a calyx wing that may expand to 1/2 in. wide. Flowering period June and July. Fruit matures on plant from September through October; wind-blown.

Typical of undrained depressions in salt deserts and associated with pickleweed *Allenrolfea* and salt grass *Distichlis*. Loses little water and gets an adequate supply because of extensive root system. Geologists consider it an indicator of a near-by supply of fresh ground water even though salt may be present at a depth of 1 ft.

Cattlemen consider greasewood a valuable fall and spring browse even though it contains oxalates of sodium and potassium. Thousands of sheep have been killed by it in early spring in New Mexico, Nevada, and Oregon. Symptoms of poisoning are weakness, weak pulse, poor respiration. Tender twigs are cut, washed, boiled, and eaten with butter by man.



Amaranth Pigweed



Iresine



Pokeweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Chenopdiales

Family Amaranaceae

Redroot Pigweed, Green Amaranthus

Amaranthus retroflexus

Height to 9 ft., erect, branching profusely, coarse, rough and, in winter, with fruit-bearing clusters that persist. Commonest at branch tips. Leaves alternate, to 6 in. long, rough, dull green, long-petioled, with wavy margins; not persisting on winter stalks. Roots comparatively small, extending directly downward, red, with few side roots.

Waste places, gardens, and cultivated fields where ground is not already occupied by sod throughout North America except in extreme north. Came from tropical America by way of Southwest. Widely established wherever agricultural seeds are planted in suitable territory. May act as a crude tumbleweed but *A. graecizans* is better example.

Flowers inconspicuous, 3-bracted, 5-stamened, greenish. Bracts pointed, stiff, longer than flowers which appear hidden among them. Pollination by wind or by self from July through September. Each flower 1-fruited and 1-seeded. May mature seeds in a few weeks or months. Seeds may remain viable for many years.

Does not thrive in shade but competes too successfully with economic plants in sun. Host in July and August of stalk borer *Papaipema nitela* and of larva of skipper butterfly *Pholisora catullus*. Some protection against being eaten by cattle because of rough nature and stiff bracts. Fruits naked, shining lenses.

Provides abundant food and shelter for winter birds. Young growth cooked like spinach; good with strong-flavored greens. Small, shining fruits, parched or ground and used by Indians as food. Young plants, eaten raw as salad. Control by cultivation, burning, and preventing formation of new seed.

Iresine

Iresine herbstii

Height to 6 ft. in tropics, grown mostly for foliage; in most gardens, not producing erect, flower-bearing stalk that looks much like top of amaranth pigweed. Leaves to 5 in. across, with deep notch in tip, normally about 2 in. long, nearly round in general effect, purplish-red, with yellowish or greenish veins.

Native of South America, where it is probably perennial. Grown widely in greenhouses and in formal gardens and named in honor of Herb t, a propagator in Royal Botanic Gardens at Kew, England. Some relatives are almost shrubby in nature. *I. lindenii*, commonest other garden species, has pointed leaves, without terminal notch.

Flowers not common in gardens, small, hidden by bracts as in amaranths. In practice, plants propagated by cuttings made in fall, kept over winter in cool greenhouse, in February given more heat, and in March given more heat and water and cut back. Cuttings root readily if properly conditioned; set 6 in. apart for mass bedding.

General culture of iresines, like that of coleus, such as is found in almost any house-plant group. Great variety of horticultural forms made by cuttings produces bronze, blood-red, greenish, yellowish, and other types. Frost is fatal to foliage of these plants outdoors.

While these plants are primarily of importance as house or bedding foliage plants, one species *I. paniculata* grows wild in dry soil from Ohio to Kansas and south to Florida and Texas. About 20 species native of warmer parts of the country, particularly in the Southwest.

Family Phytolaccaceae

Poke, Skoke, Inkberry

Phytolacca americana

Height to 12 ft., smooth, sparingly branched, strong-smelling, weak, with stem interior divided by disks that form lens-shaped cavities, easily broken down. Leaves pointed at both ends to 12 in. long, with petioles to 4 in. long, smooth, deep green, somewhat drooping. Root sometimes to 6 in. diameter, spreading. Perennial.

In open or in woods, where it is dry or wet, from Maine to Minnesota through Ontario, south to Florida and through Arkansas to Mexico, also in Bermuda. Commonly grows in groups of a few plants, rarely forming any extensive stand, and possibly is most common at borders of woodlands though this should not be considered a rule. Tropical origin.

Flowers borne along short stems that arise from bases of upper leaves. Calyx of 4-5 persistent round sepals. Stamens to 30, inserted at base of sepals. Fruit juicy, black berry, bearing 5-15 seeds. Flowering time July through September, fruits remaining on even after leaves have been destroyed by frost. Seeds probably bird-borne.

Contains bitter acid substance like saponin and alkaloid phytolaccine. Humans are poisoned by eating roots or berries, which act as a slow emetic, causing vomiting about 2 hours after eating, also purging, spasms, convulsions, and sometimes death due to paralysis of respiratory organs. Juice from berry provides a primitive and relatively permanent dye.

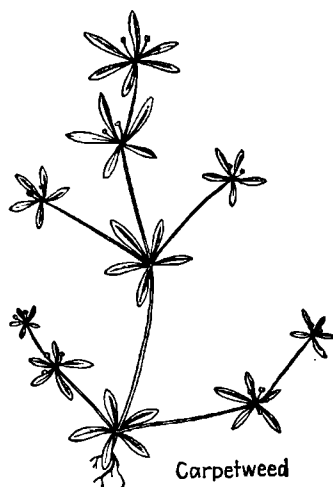
Young shoots may be cooked and eaten safely and taste much like asparagus. Only shoots under 4 in. long should be used. Cut shoots are boiled, the first water being then discarded; then, cooked again and served like asparagus. Root poisonous. Berries are not edible and should be avoided at all times as food.



Bougainvillea



Wild Four-o'clock



Carpetweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Chenopodiales

Family Nyctaginaceae

Bougainvillea

Bougainvillea glabra

Height to 10 ft. or more when allowed to grow unhindered. Sometimes may develop a trunk to 1 ft. or more in diameter, or may grow as a sprawling, woody plant over buildings, walls, or banks. Common porch and arbor vine of the tropics and warm countries and tremendously popular in Hawaii. Leaves oblong lanceolate, smooth, bright green.

Native of Brazil, but grown widely as an ornamental in the warmer and tropical parts of the world and to some extent grown in pots and kept as a dwarf form in the temperate regions in greenhouses. About 10 species, all native of South America, and a number of varieties based on flower color and other characters.

Flowers enclosed by great, showy bracts that are purple or more commonly magenta-colored; some, a deep rose and distinctly, rather conspicuously veined. Commonly grown by cutting young shoots a few inches long and rooting them in a few weeks in sand at 65-70°F. Fruit a 5-ribbed nutlet.

Withstands drought remarkably well. May be pruned severely without seriously affecting surviving plant. Cuttings made in 6-12-in. lengths in April, May, or June. Stock is taken from old in early autumn to be grown indoors for early blooming effects. Plants used in bedding, prostrate on ground.

This plant lends much color to arroyos and fences in California and Hawaii and obliterates many obnoxious weeds. Named after French navigator Louis de Bougainville, who died in 1811. The name has new significance after World War II.

Wild Four-o'clock

Oxyhaphus nyctagineus

Height to over 4 ft., with 4-sided stem repeatedly forked in upper portions, nearly smooth. Leaves opposite, entire, petioled, heart-shaped blade, to 4 in. long and to 3 in. wide, acute-tipped, but uppermost leaves mere bracts on stem, smooth, relatively dark green. Root thick, fleshy, vertical taproot. Perennial.

Native from Manitoba to Illinois, through Minnesota, south to Texas and Louisiana, being most common on dry soils such as are of wasteland type. Found in isolated areas to east of range given. Some 5 species in eastern part of United States. Garden four-o'clock is *Mirabilis jalapa* of same family.

Flower bears 3-5 stamens and pistils together in same flower, in expanded structure on hairy, slender stems that spring in clusters in forked terminal areas. Fruits hard nutlets, 5-ribbed, angular, brown, about 1/8 in. long, borne apparently from colored "involucre" that persists, appears corolla-like, and is rose or purple.

Weed that propagates itself by seed and by root. Roots easily destroyed if plants are cut in dry weather. Spreads freely from seed and so, to keep in control, plant should be cut close to ground to injure roots and to prevent seed formation. Garden four-o'clock may be grown from seed, or roots may be lifted in fall as dahlias are.

Wild four-o'clock an interesting and common weed through Middle West. In garden four-o'clock, flower part is a colored calyx and flower clusters are surrounded by a group of bracts in some related species. Erroneously supposed that jalap, a purgative, came from root of garden plant. It comes rather from *Exogonium jalapa*.

Family Aizoaceae

Carpetweed

Mollugo verticillata

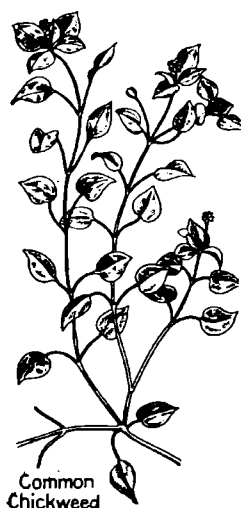
Prostrate, sprawling weed, spreading in all directions from a common central root system to form a patch sometimes 20 in. across and often making an almost conventional design by regular branching system. Leaves borne in whorls of 5-6, at branching joints, narrow, entire, to 1/2 in. long, narrowest at base. Root rather deep. Annual.

Common on sandy river banks, in sandy gardens, roadsides, and waste places in mid and late summer from New Brunswick and Ontario to Minnesota, on to Washington, south to Florida, Texas, and Mexico. Native of warmer parts of America; probably spreading, though not likely through being a commercial seed impurity. Also in Africa.

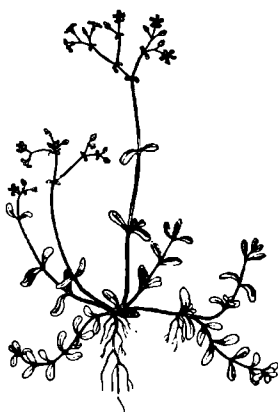
Flowers borne in axils of some leaves, particularly of whorls near branch tips, under 0.1 in. across, with sepals oblong and slightly shorter than mature capsule that develops as fruit. Seeds somewhat kidney-shaped, smooth, shining, red, and almost dust size. Flowering period June through September.

Apparently plant does best in loose, dry soil that will not support many garden plants. Does not appear in early spring, but later when conditions more nearly approximate the climate of the South and West.

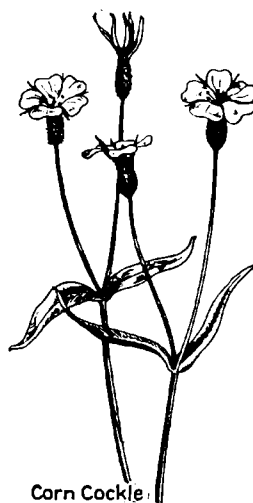
As a weed, is not serious since it is kept in control by reasonably clean cultivation in late season or by hand hoeing of isolated plants. It bears common names of devil's grip, Indian chickweed, whorled chickweed as well as carpetweed, so must be well-recognized or it would not have gained these names.



Common Chickweed



Mouse-ear Chickweed



Corn Cockle

PHYLUM SPERMATOPHYTES. CLASS DICOTYLEDONEAE

Order Caryophyllales. Family Caryophyllaceae

Common Chickweed *Stellaria media*

Height to 16 in., much-branched, weak, sprawling or rising at ends, smooth stems, except for lines of pale hairs along stems and branches. Appears as pale, fresh green, tufted mass of weak vegetation. Leaves opposite, to $1\frac{1}{2}$ in. long, the lower on rather long petioles; the upper with none. Blades of leaves sometimes heart-shaped. Roots relatively weak. Annual.

In waste places, meadows, gardens, along foundations of buildings, or in cracks of neglected paths and roadways throughout most of North America. Naturalized from Europe, native of Asia; almost universally distributed through temperate parts of world. Found in bloom in northern states at any month of year.

Flowers to $\frac{1}{4}$ in. across, with pale green sepals and deeply 2-parted, whitish petals, the sepals being longer. Stamens 3-7 and about as long as pistil. Pollination by insects or self. Fruit a capsule longer than the persistent calyx, yielding many rough, wrinkled, reddish, somewhat flattened seeds that are blown by wind rather easily as sand.

Grows most vigorously during cool weather, when there is ample moisture; can bear mature seeds in dead of a northern winter in reasonably protected place. Can be kept in control by simply raking tops off, by shallow cultivation, or by hand weeding. Spray of iron sulfate (100 lb. to a barrel of water) solution is most effective in destroying plant.

Plants eaten by pigs, chickens, and even by human beings. Leaves or whole plant eaten raw as a salad or cooked like spinach, in which case spinach taste is closely duplicated. Eaten in Europe much more commonly than in America. Handful of chickweed mixed with some mild mustard makes an acceptable emergency salad on almost any field trip.

Mouse-ear Chickweed *Cerastium vulgatum*

Height to 18 in., branches being erect or rising from a sprawling base, sticky, fuzzy, tufted, and rather weak but tougher than in common chickweed. Leaves opposite, the upper to $\frac{1}{2}$ in. long, the lower longer; blunt, hairy (like a mouse ear). Roots at joints to form dense masses, particularly in lawns and dry meadows. Biennial or perennial.

Native of Europe, North America, northern Asia, and widely established in Western and Southern states, in fields, woods, pastures, and other places where it may, in some cases, become a bad weed. Particularly in lawns it may crowd out more desirable grasses and clovers. It may grow even on rocky banks where there is little soil.

Flowers few to several, borne at or near tips of branches on individual stems in loose formation. Sepals, 4-5. Petals 5, each deeply cleft, giving effect of 2, white. Stamens usually 10. Pistil about as long as stamens. Fruit, 1-celled capsule, to $\frac{1}{2}$ in. long, bearing many kidney-shaped, roughened, flattened, chestnut-brown seeds.

Cannot survive cultivation practices. In lawns, stems may be broken loose and removed by simply raking and permitting resultant bare spot to be occupied by other more useful plants. Spray of iron sulfate or even of dilute sodium chloride is often sufficient to eliminate plant; as spray sticks readily to hairy leaves and stems.

Chickens may feed on this plant but it is not ordinarily so recognized as an emergency food for man as is common chickweed. While it is a recognized weed, it is easily eliminated and so can hardly be called a serious pest. A half-dozen species of genus to be found growing wild in East; many more elsewhere in world.

Corn Cockle *Agrostemma githago*

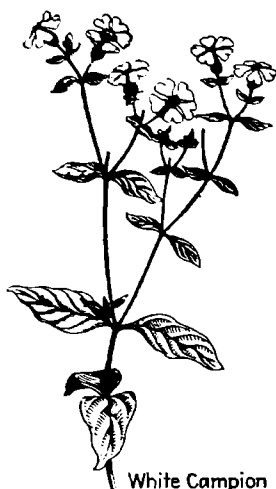
Height to over 3 ft., unbranched or bearing a few branches, erect, densely covered with whitish, appressed, somewhat sticky hairs. Leaves linear or nearly so, sharply pointed at either end, erect, to 4 in. long, $\frac{1}{4}$ in. wide, the lower ones being narrowed much at base, with a rather conspicuous midrib. Annual, or sometimes biennial.

In waste places, and more particularly in grainfields, of varying abundance, in certain localities being very abundant. Native probably of Europe and of northern Asia but widely introduced wherever small grains are grown. Often found as winter annual in fields of winter wheat and rye surviving winter with these plants. Not common on roadsides.

Flowers showy, to 3 in. broad, purplish-red, often spotted with black but paler in spots. Calyx 3-4 times length of corolla tube, exceeding petals, slender, leaf-like, dropping off in fruit. Flowering time July through September. Fruit a capsule containing many triangular, kidney-shaped, black seeds, with coarse tubercles on them.

Control by planting clean grain or by harrowing grain crop just before it emerges from ground, and again when it is 3 in. high or, where there is bad infestation, letting land lie fallow through summer. Seeds rarely hold their vitality more than 1 year and if plowed under are lost. Best cure is to use only clean seed.

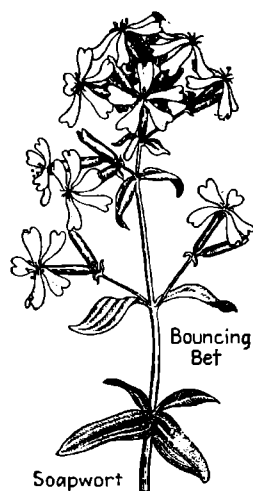
Feeds made from screenings containing any considerable number of corn cockle seeds may be dangerous to poultry and stock as seeds are definitely poisonous, the poison being the glucoside githagin which makes suds, causes vomiting, nausea, vertigo, and diarrhea. $\frac{1}{4}$ lb. of ground seed to 100 lb. live weight of animal may be fatal.



White Campion



Night-flowering
Catchfly



Bouncing
Bet
Soapwort

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Caryophyllales. Family Caryophyllaceae

White Campion
Silene alba

Height to 2 ft., with stems erect or loosely branching, sticky, with mass of fine hairs. Leaves opposite, to 3 in. long, pointed at ends and tapering at bases or joining around stem with opposite leaf. Upper leaves without petioles. Basal leaves may form a rosette arising directly from perennial, rather substantial, vertical taproot.

Found in meadows, waste places, roads, along paths, on railroad embankments, from Nova Scotia through Ontario to Michigan and even on to Pacific Northwest, south through New York and Pennsylvania. Native of Europe. Commonest as a weed in United States in East on rich, well-drained soils that have been free from cultivation.

Flowers few, in loose clusters or solitary; some staminate; others, on other plants, staminate. Sepals 5, joined into tube enclosing 5 petals that are pink or white, much longer than calyx, 10 stamens, and 1 pistil. Fruit, dry capsule, that opens at end freeing many kidney-shaped, gray to tan seeds that are coarse tubercles.

Flowers open in evening rather than at midday. Plant is a weed but not serious one since it yields to competition of any clean cultivated crop or to mowing. Scattered plants may be pulled by hand and plants that survive should be cut before they mature seeds to avoid a repeated appearance. Short crop rotation generally fatal.

Many common names testify to fact that this plant has wide distribution and is well-known. It is known as bull-rattle, cow rattle, white robin, snakeflower, thunderflower, and cuckoo flower. It resembles a night-flowering catchfly but has 5 styles rather than 3.

Night-flowering Catchfly
Silene noctiflora

Height to 3 ft., branching or unbranched, with rather coarse stems that are sticky with fine, clammy hairs. Lower leaves to 5 in. long, narrowed at base into a long petiole, sticky, hairy; upper leaves without petioles, and joined with opposite at base forming a cup. Root system not elaborate. Annual or winter annual.

Native of Europe but introduced widely wherever small grains are grown; well-established in eastern North America and in Pacific Northwest; also found south to Florida and north into Nova Scotia, usually in waste places. Favors rich, gravelly soils where new seedlings have been established.

Flowers few, in clusters at tips of branches, white or pinkish, to 1 in. across, with calyx to 1.3 in. long, tubular, conspicuously veined, and loosely enclosing capsule that develops as fruit. Seeds freed from openings in end of capsule, many, kidney-shaped, gray, with dark-brown lines and blunt tubercles. Moth-pollinated.

Control by cutting plants, by mowing before seeds have had time to set, by sowing clean seeds, by using a year after fall plowing for growing of a clean cultivated crop, by harrowing young grain, and by hoeing or hand pulling. Flowers fragrant, opening at dusk and remaining open until next morning.

Has many common names such as sticky cockle, clammy cockle, night-flowering catchfly, all of which emphasize the stickiness of the plant and the frequency with which insects of many kinds find themselves stuck on plant. Stated that stickiness prevents crawling insects such as ants from reaching flowers to steal pollen.

Soapwort, Bouncing Bet
Saponaria officinalis

Height to 2 ft., erect, relatively stout, sparingly branched, smooth, leafy, rather pale green, coarse, but easily broken. Leaves opposite, entire, joined at bases with opposite leaf, to 3 in. long, with some rather conspicuous parallel veins, pointed at tip and narrowed at base. Root system a short rootstock. Perennial.

Native of Europe, but introduced early into America and now widely established in North America, being most abundant in East and in areas on Pacific Coast. In East, is almost certain to have been established in flower gardens of early settlers and to have persisted after original dwellings disappeared.

Flowers showy, bluish- or pinkish-white, or white, about 1 in. broad, bearing both stamens and pistils. Sepals 5, joined to form long tube enclosing tube of corolla. Stamens, 10. Pistil with 2 styles. Fruit a dry capsule that opens at end to free numerous black, flattened, short, kidney-shaped, tubercle-roughened seeds. Flowers July-September.

Yields a soapy material that, mixed with water, has a cleansing effect, the principle being the glucoside saponin. It is probable that taken internally this glucoside might have poisonous effects. Control is by means of spraying with sodium chlorate, by cutting the plants frequently close to the ground, by plowing, or by deep cultivation.

Was grown originally probably as a garden flower but has escaped and established itself widely. Known as fuller's herb, wild sweet William, lady of the gate, woods phlox, mock gillyflower, sheepweed, old maid's weed, chimney weed, Boston weed, scourweed, sweet Betty, and hedgeweed, giving evidence of its wide use and popularity.



Sweet William



Carnation



Garden Pinks

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Caryophyllales. Family Caryophyllaceae

Sweet William
Dianthus barbatus

Height to 20 in., with 4-angled stems; branched or not, smooth, and rather brittle. Leaves broad, flat, and with 5 conspicuous nerves, joined at base with leaf on opposite side to form a slight cup about 3-4 times as long as wide, with upper leaves the smaller, and around 4 in. long. Biennial, with substantial root system.

Native of the area from Russia to China, south to Pyrenees Mountains but widely established where it has escaped from culture in American gardens. Often persists in abandoned sites of early pioneer homes or may appear spontaneously elsewhere.

Flowers many, crowded into rather flat- or rounded-topped clusters, with 5 petals bearing a small beard at throat of tube and being rose, red, white, purple, or variegated with these colors; petals, with outer edges toothed and with beard. Fruit 1-celled, from which the flattish seeds are shed.

Seeds may be sown in August and seedlings that develop before frost should be sheltered through winter for flowers next season, or plant may be propagated by cutting perennial underground structures. Perennial pinks can survive winter but fall-planted annuals will need protection to survive.

One of the common old homestead garden flowers still found in considerable abundance and reasonably established at the sites of pioneer homes in the East. In some places, they may have spread to occupy a considerable territory almost as a pure stand, judging from the flower display in season.

Carnation
Dianthus caryophyllus

Height to 2 ft., with stems sometimes branching, and with swollen joints from which the relatively narrow, smooth, backward-curving leaves appear in pairs. Many kinds, some being bushy and hardy enough to survive being outdoors, while others are delicate and require care in greenhouses to survive.

Under cultivation for over 2,000 years. Name *Dianthus* given it by Theophrastus, some 23 centuries ago in reference to its "divine" fragrance and *Caryophyllus* referring to clove-like quality of fragrance. In Old English, plant is called "gillyflower," varieties being developed 500 years ago in England, France, Germany, and Holland.

English call flowers of one color "selfs"; those with ground color of white or yellow streaked with scarlet, rose, or purple, "flakes"; those with same ground color but marked with 2 or 3 colors, "bizarres"; those with a pure white or yellow ground color but with a colored band on margins, "picotees." This nondistinctive classification is probably as good as any.

Culture: new cuttings 3 in. long are made in January and kept at about 50°F.; in February, all but one bud removed, still kept cool; in March temperature raised to 60°F. in day, 48° at night; in April, stock is set out, and by May flowers may be harvested. From June to August plants develop vigor and are put back in benches. From September to November they may yield crop, and in December rest.

One of most universally and prolongedly popular flowers at any season of year. Makes the perfect, dignified buttonhole bouquet or mainstay for the flowers in the center of the table. Culture is a science, which pays well those who learn how to make it succeed. The State flower of Ohio.

Garden Pinks
Dianthus sp.

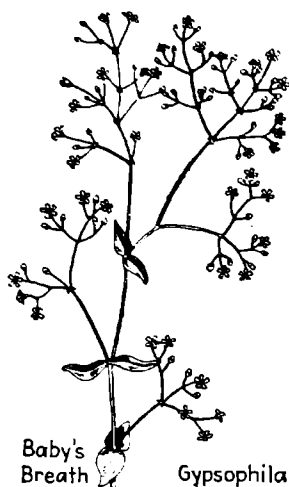
Flowers of considerable variety including sweet Williams and carnations already discussed and clove pinks. China pinks, and maiden pinks. Clove pinks *D. plumarius*, are low, usually under 1 ft. in height. Maiden pinks *D. deltoides* have short, linear leaves that are smooth or roughish, and minute flowers. China pinks *D. chinensis* usually are tall, single-flowered, broad-leaved.

Clove pinks native of Siberia on to Austria but widely established in gardens, formal and otherwise. Maiden pinks native of Scotland, Norway, and Japan and usually grown outdoors in massed beds. China pinks native of China and Japan and grown more for their individual beauty than for mass effect.

Flowers of clove pinks, pink, white, or red, fragrant, solitary or in 2's or 3's, with calyx lobes, short and broad, with pressed tips; of maiden pinks, red, with a crimson center, $\frac{1}{2}$ - $\frac{3}{4}$ in. across, with calyx bracts, narrow, pointed, and spreading; of China pinks, solitary, pink or lilac, with calyx lobes, broad to leafy and spreading.

Pinks resemble phlox flowers in many respects but differ from them primarily because petals of flowers are not grown together into a tube as in phlox, although they may appear so.

Generally speaking, pinks are hardy plants that in most cases can survive in gardens with little care, or if annual are able to yield an abundance of bloom with a minimum of care and expense. Since they are naturally found in more or less dry places, they can survive in locations and under conditions not suitable to many garden flowers.

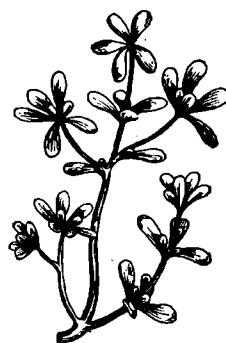


Baby's
Breath

Gypsophila



Garden Portulacca



Purslane

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Caryophyllales

Family Caryophyllaceae

Family Portulacaceae

Baby's-breath

Gypsophila paniculata

eight to 3 ft. or more erect, profusely branched, with stem fine and delicate looking. Leaves narrow, sharp-pointed, smooth, with the longer to the stem, reaching a length of 4 in.; the upper, shorter. Some varieties have wiry stems. Does not wilt readily under normal treatment. Perennial, ordinarily hardy.

Native of Europe and of northern Asia, it is established by escape from cultivation in various parts of North America. When grown outdoors, favors open, sunny, relatively dry spots such as are characteristic of many rock gardens. Of the 50-60 recognized species, most of them come from western or southern Asia, eastern Europe, or northern Africa.

Flowers small, and at many ends of the finely branching top, numerous and white, with stem supporting individual flowers 2-3 times as long as calyx of flower itself. Some double varieties have been known but they are not easily grown. Plants may be grafted on roots of established plants.

The name implies that plant favors soils with lime in them but common name refers to effect of the whole plant as like appearance of one's breath on a cold day. This species is grown in greenhouses for sale as cut flowers to "lighten up" a bouquet, or is allowed to grow in gardens to fill in bare spots.

Planted in masses in gardens, the flowers have a dainty appearance to a spot that might otherwise appear bare. The cut flowers seem to be favorite cut flowers for weddings, funerals, and for banquet centerpieces, when used with other, more stolid species.

Garden Portulacca

Portulacca grandiflora

Sprawling, or slightly ascending stems that are succulent, sparingly branched, and to 1 ft. long. Leaves alternate, round in cross section, about 1 in. long, 0.1 in. thick, and more clustered near tips of branches. Scattered hairs or hair tufts may be found on stems or in leaf axils. Root, a central taproot.

Found in gardens where showy flowers are desired and where soil is sufficiently dry and sandy. Introduced from South America but widely established as indicated by the many common names that indicate a locality. "Mexican rose" is more appropriate than "Kentucky moss" as a significant place name.

Flowers to 2 in. broad, brilliantly pink, white, yellow, or red, but open only in the bright sunshine. Petals 5, and slightly cleft at tips. Stamens many. Fruit like other portulacas, a capsule that opens by a lid at the top to free many seeds. In this species, seeds are shining gray and small.

Term *moss* commonly used in describing this plant of course refers to remote resemblance of the plant to a moss when flowers are not present. Common name "rose" refers to resemblance of flower to a rose. Neither a rose nor a moss. Limitation of flowering to hours of bright sunlight interests many people.

One of common garden flowers, its seeds are readily available. Showy flowers pictured are intriguing but results are often disappointing because plants cannot stand competition and must have a relatively dry loose soil in which to do best. Known as wax pinks, French pussley, and showy portulacca.

Pussley, Purslane

Portulacca oleracea

Sprawling plant, with stems to 10 or more in. long, radiating from a central root system that penetrates the soil rather deeply. Stem smooth, succulent, easily broken, much-branched and green. Leaves to nearly 1 in. long, fleshy, rounded at the tip, alternate, clustered at ends of branches, easily broken from stem. Annual.

Common in gardens and waste places, in bare spots on lawns and in door-yards. Native of Europe and of our Southwest, it being essentially a plant of warm and tropical America. Naturalized and cultivated in Europe and is considered a useful food plant in some parts of the world.

Flowers inconspicuous, yellow, solitary in axils of leaves, to 1/4 in. across, with broad, green sepals and 5 petals. Pollination largely by bees and by butterflies. Flowering time from July through September. Fruit small capsule that opens by lid, shedding many fine dust-like, flattened, wrinkled seeds. Seed to seed in few months.

Frost kills plant normally. Flowers are open only for few hours in early morning. Plant is able to survive pulling if parts of it can fall on moist ground where they will root. Plant harbors a white mold but can be destroyed by repeated hoeing while plant is still in seedling stage and by taking care to destroy hoed plants. Good pig food.

Plant may be eaten raw, or cooked by steaming or boiling and adding a little salt. Makes good salad greens if collected reasonably young and eaten with other plants with a stronger taste. Mixed with mustard and lamb's-quarters, it may be really good. Sold regularly in food markets in China, India, France, and Mexico.



Bitter Root



Carolina
Spring Beauty



Virginia
Spring Beauty

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Caryophyllales. Family Portulacaceae

Bitterroot
Lewisia rediviva

Practically stemless plants. Leaves arise directly for most part from top of coarse root, narrow, oblong, nearly round in cross section, smooth. Flower-bearing stems little if any longer than leaves. Root coarse, vertical, loaded with starch, and with a bark which is very bitter but which slips easily from the root at flowering time.

Found in open fields from Montana to Arizona, and to some extent north and west of these centers of abundance. Is not limited to natural range as it is commonly grown in rock gardens and similar places as a low ornamental that can survive difficult climatic conditions. Over a dozen species, of which this is by far most important to man.

Flowers conspicuous, rose or white, borne singly, with to 8 persistent, bract-like sepals, and to 16 spectacular petals. Stamens many. Fruit, capsule that breaks by means of a line running around tip and opening somewhat like a lid, freeing many seeds from within. May be reproduced from root or from seeds.

White, inner part of root is starchy, mucilaginous, and at first bitter, but bitterness is removed by boiling, after which root is edible. Indians collected and dried it, first chipping off bitter bark. It could then be stored and when boiled regained its food value and mucilaginous qualities. Collections were made in spring months.

State flower of Montana. Long a favorite food with Indians. Oregon Indians called it "spatum" and it is after this plant that the Bitterroot Mountains were named. Mucilaginous qualities of root make it possible for plant to survive in areas which may be dry for considerable periods of time.

Carolina Spring Beauty
Claytonia caroliniana

Height rarely to 1 ft. Less likely to sprawl than is Virginia spring beauty. Basal leaves to 3 in. long, $\frac{3}{4}$ in. wide, being conspicuously proportionately wider than in Virginia species. Upper leaves borne on petioles to $\frac{1}{2}$ in. long. Root broad, deeply buried, with smaller roots coming from many places.

In damp woods, from Nova Scotia to Saskatchewan, south to Connecticut, in highlands to North Carolina, and in west to Ohio and Missouri. In Virginia, found up to 5,000-ft. elevation but is rare near seacoast. A related *C. lanceolata*, with shorter leaves is found from the Rocky Mountains to the Pacific coast.

Flowers similar to those of Virginia spring beauty but usually fewer and more likely to be smaller. Flowering period from March through May. Flowers open only when exposed to sunlight. They close relatively quickly if plant is plucked. Pollination by insects seeking nectar and pollen.

Common pollinators are bee-like flies Bombyliidae, the bumblebees, *Bombus vagans* and *B. pennsylvanicus*, the bees, *Halictus* and of the family Andrenidae, the yellow butterfly, *Colias*, and the brown and black *Papilio ajax* butterfly.

Both spring beauties can be purchased from those who supply stock for wild gardens. A few bulbs given care may in a few years produce many. Spring beauties should not be picked, since picking the leaves as well as the flowers deprives the plant of survival.

Virginia Spring Beauty
Claytonia virginiana

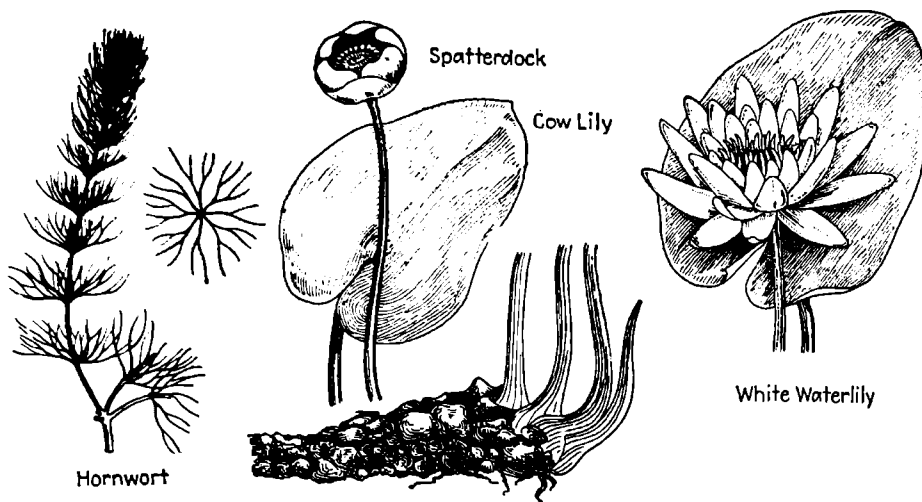
Height rarely to 1 ft., rarely branched, erect or somewhat sprawling, succulent, smooth, easily broken, bearing 2-3 leaves, the upper being opposite and shorter than the basal that are to 7 in. long and $\frac{1}{2}$ in. wide. Plant not active long during year but arises from a deep, tuberous root, shaped something like a chestnut.

Found in early spring in moist woods from Nova Scotia to Saskatchewan and Montana, south to Georgia and Texas. Usually grows associated with trees of a mixed forest rather than in a pure stand type of forest. Not common near evergreen trees. May survive forest clearing for a year or so.

Flowers white or pink, or with flesh-colored markings, to 0.4 in. across, in loose, open clusters at top of plant, on individual stalks to 1.5 in. long. Petals 5 distinct, somewhat notched at tip. Sepals, 2, persistent. Stamens 5, fastened to base of petals. Fruit, capsule that is shorter than sepals. Seeds many and small.

Even in winter thaws, this plant may be making progress to be ready to bear flowers as soon as light conditions are suitable. One of first of spring flowers. Unfortunately is attractive enough to be collected by flower pickers but is not a good bouquet flower since it wilts quickly and soon looks bedraggled.

Bulbs are starchy and may be eaten raw or boiled. However, the flowers are so attractive as they are that the bulb should not be collected for food except in an emergency. Even then the amount of food gained may hardly justify the energy expended in its collection.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ranunculales

Family Ceratophyllaceae

Hornwort

Ceratophyllum demersum

Submerged, aquatic plant, with weak stems sometimes 8 ft. or more long, with no roots at any time, with leaves in whorls of from 5-12, slender, forked 3 times; with segments, stiff, rigid, and with toothed margins, to $\frac{3}{4}$ in. long, easily broken from stem, conspicuously crowded at growing tip giving rise to common name coontail.

In ponds and slow streams, particularly where water is hard, throughout North America except in far north and in Cuba. Variations which are sometimes conspicuous probably are not sufficient to warrant establishment of many species; only 1 is recognized, variations chiefly being in length and arrangement of leaves on stem. Known in Europe.

Terminal flowers having from 10-20 stamens, usually found at different points along stem though sometimes they may be separate flowers at same point. Fruit to $\frac{1}{4}$ in. long, varying in appearance from being winged or lined or warty; 1 seed per fruit, some ossifying plants with spiny fruits in a variety *echinatum*. Anthers float free in pollination.

Provides food and admirable shelter for small shrimps that are eaten by useful fishes. Known that muskrats eat plants and some ducks eat either fruits or tips of plants themselves. Plants may be so abundant as to clog waterways seriously. Also may assist in pollution. In fall, tips break, sink, act as winter buds. Require little light.

Ducks known to feed on fruits or plants include black duck, baldpate, bufflehead, canvasback, goldeneye, mallard, pintail, redhead, ringneck, ruddy, blue-bill, shoveler, scoter, wood duck, blue-winged teal, and green-winged teal. Used sometimes as an aquarium plant in spite of its odor and rapid growth.

Cow Lily, Spatterdock

Nuphar advena

Leaves oval, with blades to 12 in. long and 9 in. wide, on petioles that are spongy and 1 ft. or more long; floating, or sometimes erect or submerged, growing from end of a thick, spongy rootstock, from 3-4 or more inches through; sometimes 1 yd. or more long, with weak, white, smaller side structures, and conspicuous triangular and circular scars.

Found in fresh or acid (to pH5) ponds and slow streams or at their edges or to depths of 6 ft. from Labrador to Nova Scotia, west to Rocky Mountains, south to Florida, Texas, and Utah. In few cases, is grown in artificial pools but not so commonly as those with more attractive and fragrant flowers. 6 species in United States; 25 in world.

Flowers to $3\frac{1}{2}$ in. in diameter, like flattened globes, with 6 sepals; petals fleshy and under $\frac{1}{2}$ in. long. Flowers appear yellow, with a purple tinge mostly on outside. Stamens, many, in 5-7 rows. Disc of pistil yellow or red, with 12-24 parts. Fruit egg-shaped, to 2 in. long and 1 in. thick, with many seeds inside. Seeds should be stored wet.

Thick rootstocks, eaten raw by deer and men, taste sweet. May be boiled with meat or roasted. Indians used to collect them in fall or steal them from caches in muskrat houses, according to some records. Deer eat leaves and flowers and beaver eat submerged parts as do porcupines. Sometimes plants crowd out other water plants. Ducks eat seeds.

In Northwest, closely related *N. polysepalum* yields seeds that are important food to Klamath Indians. Seeds are extracted after pods have been dried, then parched to loosen covering and after covering is removed, contents are again parched and increase in size like popcorn. Seeds stored or ground as flour and used in breadmaking.

Family Nymphaeaceae

Sweet White Water Lily

Nymphaea odorata

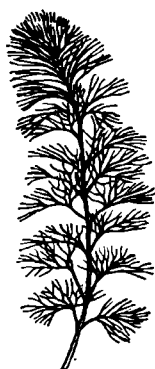
Leaves with round blades that float and have a single break from margin to center. Blades to 1 ft. across, smooth, green, shining above, covered with algae and small animals usually beneath. Petioles reach from buried rootstock to water surface and have 4 main air channels. Underground tubers 3-4 in. thick, fleshy, with tuberous offshoots.

In ponds and slow streams, where water level does not change radically from Newfoundland to Manitoba, south to Florida, Louisiana, and Kansas, with related species extending range west to Idaho, with plant established as an ornamental in pools in many parts of the world. May spread by means of tuberous offshoots that establish new plants.

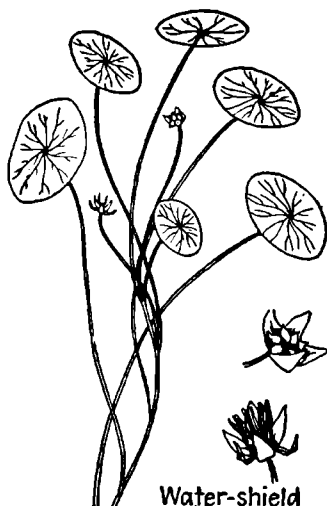
Flowers white, with a center of yellow stamens. Petals sometimes pink. Flowers to 6 in. across, remarkably fragrant, and in absence of sun, enclosed by green sepals. Fruit globe-like or somewhat flattened, of 12-35 cells, with seeds enveloped. Flowers float on water surface or held above it. Fruits ripen beneath water surface. Seeds float.

Some botanists recognize 2 species: *N. odorata* that is fragrant and has flowers open from 7 A.M. to 1 P.M. with flowers seldom over $4\frac{1}{2}$ in. across with no purple on the petiole; and *N. tuberosa* with less fragrant flowers that may be over $4\frac{1}{2}$ in. across and open from 8 A.M. to 3 P.M., and with 4-5 purple petiole streaks.

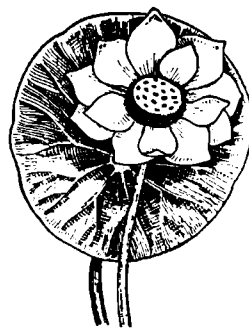
Tubers well-filled with starch, with food value. Fruits of some relatives gathered by natives, allowed to decay to free seeds that are then washed, dried, stored, parched, and eaten. Seeds contain starch, oil, and protein and are considered very nutritious. Tubers are almost solid starch and treated as though they were potatoes. Ducks eat seeds.



Cabomba



Water-shield



Lotus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Nymphaeaceae

Cabomba, Carolina Water Shield
Cabomba caroliniana

Stem slender, underwater, to several feet long, branching, weak, with a gelatinous slime. Leaves opposite or whorled, with thread-like divisions, arranged like a fan, petioled, to 2 in. broad, with floating leaves, alternate or opposite, with blades narrowly oblong and to 1 in. long.

Found in ponds and slow streams. From Missouri, Illinois, and Michigan south to North Carolina, Florida, and Texas and possibly introduced in western Massachusetts. Found in almost any state wherever aquarium supplies are sold.

Flowers borne on long stems from bases of uppermost leaves, to $\frac{3}{4}$ in. across, white or yellow, but not particularly conspicuous. Plant is reproduced by merely breaking stem and letting new growth take place.

Used as food, shelter, and ornament in household aquarium, the food and shelter of course being for occupants of aquarium. Seems to be relatively free of offensive odors that may come from hornwort, looks less brash, and leaves less trash possibly because it is eaten by aquarium fish.

Stems may be anchored in aquariums by burying ends in sand but plant seems to do reasonably well without such help. Not common for aquarium plants to produce oval floating leaves and flowers, so this may be evidence that it is merely existing rather than living as it might in its native waterway.

Water Shield
Brasenia schreberi

Leaves with blades to 4 in. across and 2 in. wide, almost circular and without slit common in water lilies. Leaves and petioles covered with a clear mucilage. Petioles flexible and long enough to reach from buried slender rootstock to water surface; attached to middle of blade. Rootstock branches rather freely.

In ponds and slow streams, from Nova Scotia to Florida, west through Manitoba, Nebraska, and Texas, also along Pacific Coast from Washington to California, and in Asia, Africa, and Australia. Does not seem to be so abundant as water lilies that have a more limited distribution but locally may be common. Found also in Cuba and Mexico.

Flowers inconspicuous, to 1 in. across, on stout stems reaching from rootstock to water surface, with 3-4 sepals and 3-4 petals that are purple or mauve. Fruits a cluster of club-shaped pods to $\frac{1}{2}$ in. long, enclosed in calyx when mature and rarely conspicuous at any time. Flowering time June-August.

Japanese eat young mucilage-covered leaves and stems as a salad, with vinegar. Indians of California commonly collected tuberous roots that are full of starch and ate them as a salad. Rootstocks in condition to be collected for use as food from autumn through spring months. Starch tubers may be baked, boiled, or eaten raw.

One of prettiest of water plants if one does not demand attractive flowers. Many common names such as deerfood, frogleaf, little water lily, water target, and water shield. Reported as food of black duck, canvasback, bluebill, mallard, pintail, redhead, ruddy, and other ducks. Fourth most important Gulf Coast duck food, exceeded only by bulrush, smartweed, widgeon grass.

American Lotus
Nelumbo pentapetala

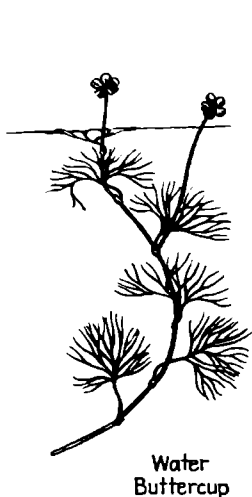
Leaves huge shields, almost circular in outline and to 2 ft. across, appear raised above the surface of water and arise from rootstock that may be 50 ft. long and bears tuberculous enlargements that in fall are well-filled with starch but these may be well-buried in mud under water and not easily accessible.

In ponds, mud-bottomed marshes, and lake margins from tropical America and the Gulf States north to the Great Lakes region, from northern Minnesota and Nebraska through southern Ontario to Massachusetts and southern Connecticut but highly localized in North and often exterminated there.

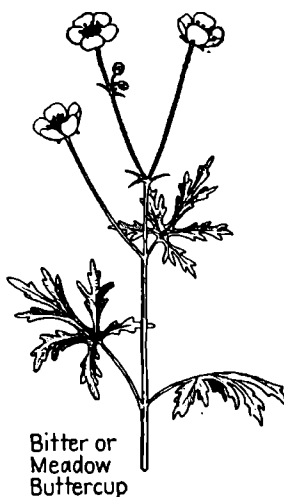
Flowers like pale yellow water lilies, to 10 in. across. Sepals and petals numerous and in many rows. Stamens numerous and shed early. Pistils several to a flower and embedded in a swollen receptacle in which the fruits rattle around when maturity is reached, each $\frac{1}{2}$ -in., hard, globular seed or fruit remaining in its own separate cavity.

Crisp tubers and growing tips of rootstock are baked for food and taste much like sweet potatoes. Seeds are size of acorns and when half-ripe taste like chestnuts. Ripe seeds are roasted and starchy interior is eaten dry, baked, boiled, or made into bread. Seeds may be collected even in winter. Leaf stalks and young leaves are also edible.

Related lotus of China and Egypt grown extensively for food, seeds being a regular food in China; rootstocks systematically cultivated. Because of rarity and beauty, plants in North should not be considered a food source but in South might be developed. Common names include sacred bean, water chinquapin, and nelumbo. Superior breeding site for malarial mosquito.



Water
Buttercup



Bitter or
Meadow
Buttercup



Swamp Buttercup

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Ranunculaceae

Water Buttercup
Ranunculus aquatilis

Submerged, with weak, flexible stems, over 1 ft. long, branching. Leaves to 1 in. long, fan-shaped, divided again and again into almost thread-like segments, unable to stand erect out of water, with no flat, floating leaves such as are found in the yellow water crowfoot *R. delphinifolius*.

Common in shallow water from Labrador and Nova Scotia to North Carolina, west to Lower California and Alaska. A number of varieties are recognized, named by some in genus *Batrachium*. Most abundant apparently in the North-west where it is recommended as a wild-food plant. Found also in Europe and Asia in one or more forms.

Flowers solitary, white, $\frac{1}{2}$ – $\frac{3}{4}$ in. across, on weak stems to 2 in. long. Flowers float at water surface. Many stamens and many pistils per flower. Fruits to $\frac{1}{2}$ in. across and borne on airy receptacle held near water surface. Blooms from June through September. Apparently many closely related species with minor differences.

Definitely aquatic, though can survive on shore conditions. Can survive 500 parts of alkali per million of water and 1% or less of sodium chloride. Cannot survive more than 1.0005 percent gravity. May form dense mass of growth even in relatively swiftly moving water such as is found in brooks.

Of minor importance as food for waterfowl and other game species. Leaves and fruits reported as found in stomachs of waterfowl. Plant studied to determine its importance to wild life. Propagated by transfer of growing material or by sowing of fruits. May be found in water to 4 ft. deep that is moderately acid.

Bitter Buttercup
Ranunculus acris

Height to 3 ft. Erect, branching, particularly in upper areas. Upper leaves without stems or with but short ones, 3-parted. Lower leaves on long stalks with blades cut or divided into from 3–7 parts radiating from a common point. Stems hollow, hairy, and branched. Roots clustered and fibrous. Plant bitter.

Found in fields and roadsides particularly where there is abundant moisture. Generally common. Ranges from Newfoundland to British Columbia, southward to Virginia and Missouri, also in Bermuda. Naturalized from Europe and possibly introduced by seed as it occurs as a seed impurity.

Flowers yellow cups, about 1 in. broad, shallow with 5 yellow petals. 2–3 times length of sepals and many times broader, borne on long, slender stems. Stamens very numerous. Pistil many to a flower, 1-seeded, compressed and short-beaked. Flowers from May through October. Insect-pollinated.

Green parts contain volatile poisonous substance that vanishes in hay. Poison affects horses, sheep, but most particularly cattle, causing inflation of intestinal membranes and producing bitter and sometimes reddish milk from dairy cattle. Because of bitter taste, plants not normally eaten if better forage is available.

Since cattle avoid this plant, it survives to produce seeds unless these are cut or otherwise destroyed. Will not survive cultivation nor drainage so control is by cultivation, cutting, draining, or encouraging rivals by good fertilization. Hay not dangerous since poison vanishes with drying.

Swamp Buttercup
Ranunculus septentrionalis

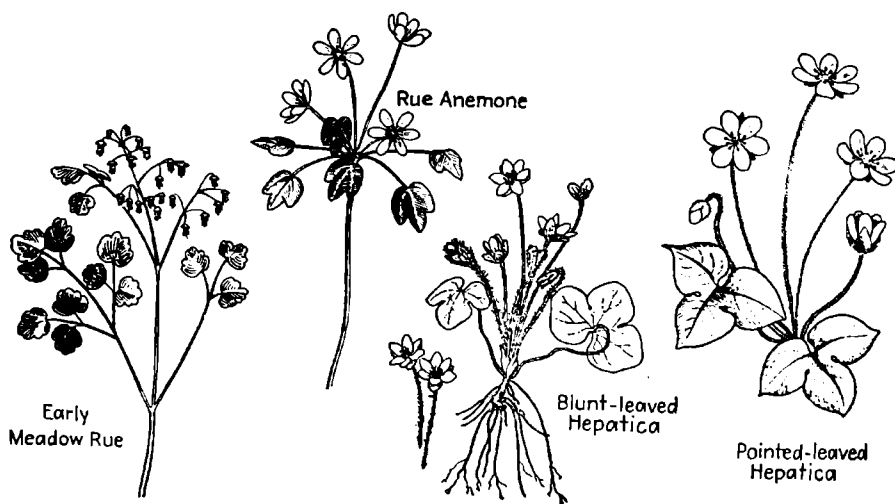
Height to 3 ft., branching. Smooth or fuzzy, usually the latter. Older branches may droop to ground and take root at joints or form long runners. Leaves unequally 3-parted, with divisions commonly stalked; long-stemmed (sometimes 1 ft. or more); divisions wedge-based. Roots fibrous and relatively weak.

Commonly in swamps and wet areas and rather commonly in shade. Ranges from Georgia to New Brunswick and west through Manitoba and Kansas with at least one established race in Minnesota-Missouri area with somewhat sticky, bristly covering on the plant.

Flowers to 1 in. or more across, bright yellow, not crowded, with 5 petals broadest near free end and themselves twice length of spreading sepals. Stamens and pistils, many per flower, with head of fruits to $\frac{1}{4}$ in. in diameter. Fruits with broad wing margins and with a beak about the length of fruit body. Flowers April through July.

Pollination is largely by the bee-like flies belonging to the Bombyliidae and the small bees of the family Andrenidae. Fire and drought may eliminate the species from certain areas though it can withstand flood rather well.

The plant is easily controlled as a weed by drainage of the soil and by only moderate cultivation. Murie has reported it as a food favored by moose in the Isle Royale area and its fruits may possibly be considered of value for some birds.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Ranunculaceae

Early Meadow Rue
Thalictrum dioicum

Height to over 2 ft. Slender, but reasonably tough, branched, smooth, pale green stems. Leaves 2 or more times compounded, of thin, pale green, widely spreading leaflets usually obscurely 3-9 lobed. Leaves relatively few. Roots fibrous and not yellow.

Found in relatively open but protected woodlands from Maine to Alabama, west to Missouri and Saskatchewan ascending in North Carolina to 4,500 ft. elevation. It is also recorded from Labrador. At least 8 closely related species in the eastern part of the United States, some favoring more open habitats than does this species.

Pistillate and staminate flowers on separate plants; pistillate inconspicuously pale green, with rather long tips to pistils, develop into clusters of ribbed, egg-shaped fruits; staminate appear as delicate clusters of lace, composed of slender anthers. Pollination probably by wind. Flowering period April and May.

Genus is represented by plants mostly of temperate zone with at least 100 known species, of which 11 are found in United States. Common Eastern species include this woodland species and a more open country *T. polygamum* or tall meadow rue. Best known Southern species is well called maid of the mist. A Pacific coast species does best along streams.

Garden species of *Thalictrum* have been developed from European and Asiatic species. Among these is the feathered columbine.

Rue Anemone
Anemone thalictroides

Height to 9 in. Smooth, delicate. Basal leaves resemble those of meadow rue and appear after the flowering stalk has developed and compounded into 3's. Leaflets all thin and pale green or olive and on long stems. Root system a cluster of small tuberous roots, generally elliptic in shape.

Found in woods that are usually thin; ranging from New Hampshire and Massachusetts south to Florida and west to Ontario, Minnesota, and Kansas. Only 1 species in the genus, found only in eastern North America.

Flowers borne in clusters of 2-3 at the top of early appearing stems and arising from a point common with the involucre leaves. Sepals 5-10, white and petal-like. Petals, none. Stamens, numerous. Pistils, to about 15 per flower and developing into 8-10 ribbed, oval fruits.

Flowering period from March through June. Name refers to resemblance of plant to meadow rue and to anemone, the flowers being like latter except that they are clustered, and leaves being like former in general appearance. Pollination by bees and bee-like flies.

Plant is sold for planting in wild gardens but since stock is generally collected from wild this does not seem to be a good practice. Roots may be eaten as "potatoes" and are high in starch content but the returns in food cannot make up for loss of beauty of the plant.

Blunt-leaved Hepatica
Hepatica americana

Height to about 6 in. Rather leathery, hairy, satiny leaves and flower stems arising from a common point close to the ground. Leaves on long stalks, with 3 blunt lobes, to 2½ in. broad, when mature resting on the ground, may be green under winter's snows. Roots fibrous and profusely branching.

Common within range, on dry or open wooded banks, in gravelly soil that may be acid or neutral, unlike related *H. acutiloba* that favors lime soils. Ranges from Nova Scotia to Manitoba and south to Missouri and northern Florida and in Alaska. To 2,600 ft. elevation in Virginia.

Flowers blue, purple, or white, saucer-shaped, to 1 in. broad, flowering from December through May in some seasons. Petals absent, being replaced by to 15 colored sepals, with green involucre acting like calyx. Stamens numerous, as are the separate, 1-seeded, hairy, pointed fruits. Pollination by bees and flies.

Tannin is extracted from full-grown leaves with alcohol and believed by some to have slight astringent value but not normally used as medicine. In past, was believed to be of value in "stirring a torpid liver" on assumption that since leaves looked somewhat like the liver they could correct liver troubles.

State flower of Missouri and of Minnesota. A most popular spring flower that survives picking rather well. Known as three-leaved liverwort, herb trinity, ivyflower, golden trefoil, squirrel cup, mouse-ear and other names, indicating its popularity. Survives some transplanting to suitable gardens.



Wind Flower



Thimbleweed



Pasque Flower

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Ranunculaceae

Windflower, Wood Anemone
Anemone quinquefolia

Height to 9 in. Nearly smooth. Basal leaves long-stemmed and appearing after the flower-bearing stem, 5-parted, with divisions pointed at base and dentate at free ends. Leaves on flower stem usually 3, 5-parted, springing from a common point. Root system rather slender, horizontal rootstock.

Common in low open woodlands from Nova Scotia to Georgia, west to Tennessee, Minnesota, and Ontario rising in Virginia to elevations of 3,500 ft. Resembles slightly the European windflower *A. nemorosa* which has escaped into territory normally occupied by our species.

Flowers single (as contrasted with many in rue anemone), to 1 in. broad, with 4-9 whitish or purple sepals and no petals. Stamens, many. Pistils rather numerous and crowded into a coarsely bristly head, each part being hooked and slightly fuzzy. Pollination by bees and early bee-like flies.

Flowers from April through June. Plant rarely is as abundant as many other spring flowers and flowers too few or leaves too many to make it popular for picking. It transplants easily and is relatively hardy in wildflower gardens.

The popularity of the plant is attested by its many common names such as thimble weed, Mayflower, wild cucumber, wood flower and so on. It is obviously more slender in most ways than its European namesake and relative.

Tall Anemone, Thimbleweed
Anemone virginiana

Height to 16 in. Densely greenish-gray, hairy. Hardly erect. Leaves much-divided and like a fuzzy bitter buttercup leaf though coarser and somewhat smaller, the lobes being slender. Rootstock thick, horizontal, bearing basal leaves and flower-bearing stalks.

Found close to the ground in dry, open, prairie lands from Illinois to Texas and west to Nebraska and British Columbia, also in Europe and in northern Asia, though the European and Asiatic forms usually have narrower leaf parts than do those of America. 18 North American relatives known.

Flowers gorgeous, solitary, blue, lavender, or white, with light centers, without petals, the sepals being conspicuous and making a flower 1 in. or more across. Stamens, many. Pistils form a cone-like structure that breaks to free long feathery individual fruits heaviest at base.

Flowers March and April. Perennial. Fresh plant produces a virile, poisonous, bitter alkaloid anemonine that may cause severe inflammation and irritation to sheep that may graze the young plants or flowers in open pasture.

Its beauty should make it a popular wild-flower-garden plant but it apparently demands certain conditions if it is to thrive. Its popularity as a spring flower is testified by its many common names such as wild crocus, prairie smoke, badger, gosling, headache plant, rock lily, and April fool.

Pasqueflower
Anemone patens

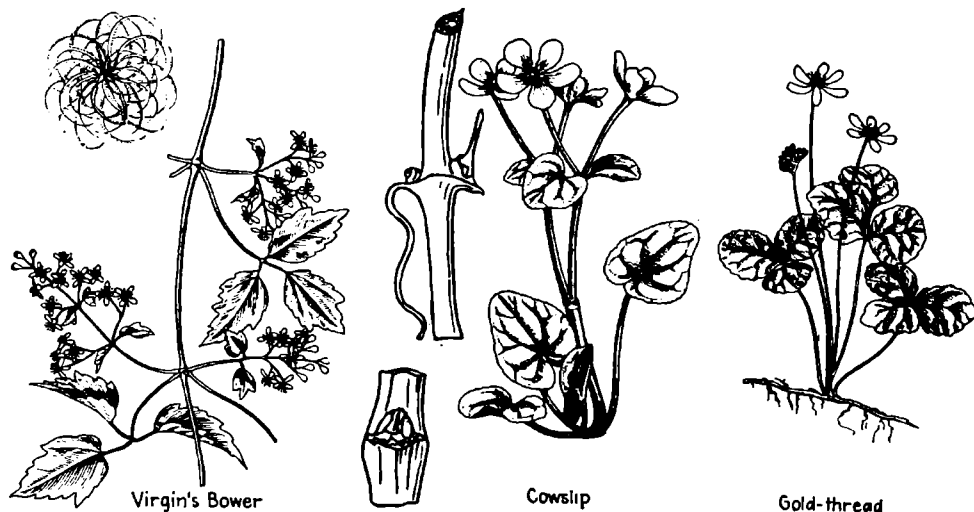
Height to 3 ft. Stem stout, rather rough, branching. Basal leaves long-stemmed, 3-parted, broader than long, with divisions wedge-shaped at bases and variously cleft. Leaves not arising from the base, on stems to 2 in. long and much like basal leaves. Roots fibrous.

Common along dry roadsides, in dry woodlands, and in some waste places from Nova Scotia to South Carolina, west to Arkansas, Kansas, and Alberta, with closely related species extending the range considerably. There are of course a number of related species that are ornamentals.

Flowers borne singly at the ends of relatively long erect stalks. Sepals 5, greenish-white or white, and blunt or pointed at the tips. Petals, none. Stamens, numerous. Pistils, many, forming a thimble-shaped head which splits to expose rather fluffy individual fruits.

Flowering period June through August. Pollination by bumblebees, honeybees, other small bees, and by syrphus flies. Other wild anemones in relatively same range include the long-fruited *A. cylindrica*; the Canada anemone with fruits that are not fluffy, and others.

The name anemone means flower, shaken in the wind. The plants are of little economic importance but of considerable esthetic beauty, although they are a bit too coarse to compete with their woodland relatives or the pasqueflower of the open prairies.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Ranunculaceae

Virgin's Bower
Clematis virginiana

Climbing vine often many yards long and sprawling over shrubs and low trees, walls, or fences. Leaves nearly smooth, of 3 leaflets, broad at base and acute or deeply lobed at tip. Stem more or less woody. Leaves and leaflets coil about support, assisting in climbing habit. Buds blunt, somewhat sunken.

Common along woodland borders, over shrubs and fences from Nova Scotia to Georgia, west to Tennessee and Manitoba. It often covers riverbanks with an intertwining mass of stems each well over 10 ft. long. Related wild species include the purple virgin's bower *C. verticillata* and leather flower *C. viorna*.

Flowers white or greenish-white, in loose, relatively open clusters, the pistillate and the polygamo-staminate on separate plants. Sepals 4, greenish-white. Petals, none. Stamens, many. Pistils develop into slender structures with long, curved, feathery tips that together make fluffy balls.

Flowers from July to September. Pollination by syrphus flies, small bees, and bee-like flies attracted by abundant nectar. From October on, the fruits make the plant attractively conspicuous and give the plant the name old-man's-beard. Also called woodbine, devil's-hair, wild hops, and devil's-darning-needle.

Sometimes cultivated as an ornamental. Handling of the leaves may cause a dermatitis to some persons. European species closely related to this one also cause dermatitis. Plant is easily propagated by pulling up sections of wild plants and setting these out.

Marsh Marigold, Cowslip
Caltha palustris

Height to 2 ft. Stem erect, smooth, mellow, branched above, rich dark green. Leaves long-stemmed, kidney-shaped to broadly heart-shaped, from 2-8 in. broad, smooth, bright dark green, with conspicuous veins, lower leaves longer stemmed than upper. Underground root system soft and spongy with fine rootlets.

Found in marshes and other wet spots, frequently forming spectacular displays. Ranges from Newfoundland to Saskatchewan, south to South Carolina and Nebraska, with two other American species found in much the same area, one more or less aquatic. Native of North America.

Flowers to 1½ in. broad, shaped like a shallow cup, bright yellow, blooming in May and June. Petals none, the sepals appearing like petals and dropping off relatively early. Stamens, numerous. Pistils 3-12 or more, splitting down one side, to 1 in. long, freeing many seeds. Perennial. Pollinated by syrphus flies and bees.

Green parts contain poisonous alkaloid jervine and glucoside helleborin, both of which are destroyed by drying or cooking plant. Sheep, cattle, and horses may be poisoned by eating green tips. Name means cup of marsh. Other common names include capers, soldier's buttons, boots, meadow boots, drunkards, crazy bet.

While green plants eaten by cattle may cause stoppage of milk, diarrhea, and stomach inflation, cooked greens are a standard spring green for human beings and are delicious. Buds are picked, parboiled in salt solution, and pickled as capers. In preparing greens, it is suggested that first water be poured off and not used.

Goldthread
Coptis trifolia

Flowering stalk to 5 in. but usually lower. Leaves evergreen, rich, dark green, shining, of 3 leaflets, each wedge-shaped, sharply toothed, and obscurely 3-lobed. Root slender, branching, horizontal, well-buried, brilliant yellow and bitter. Whole plant a thing of beauty.

Found in rich mossy woodlands and swamps where acidity is relatively high and in bogs. Ranges from Newfoundland to Maryland and Tennessee and west through Tennessee, Iowa, Minnesota, and British Columbia to Alaska, reaching an elevation of 3,500 ft. in the Adirondacks in New York. About 9 related species.

Flower 1 to a flowering stalk, though sometimes 2 are present, to nearly 1 in. across. Sepals 5-7, petal-like, dropping off early. Petals smaller, equal in number, slender. Stamens, numerous. Fruits in 3-7 parts, about ¾ in. long, spreading at the tip. Golden anthers are conspicuous in white flowers.

Pollination effected probably by fungus gnats and by a small beetle *Anaspis*. Flowering May through August. Those who know this plant always like to discover again beautiful yellow thread of the root system, no matter if it has been seen hundreds of times before.

The plants provide medicinal stock for the old-time herb doctor, possibly on the assumption that something as beautiful and as bitter as the root must have some medicinal value. The plants grow well in indoor gardens in terrariums and are popular for this reason.



Peony



Wild Columbine



Garden Columbine

PHYLUM SPERMATOPHYTA. CLASS DICTYOLEDONEAE Order Ranunculales. Family Ranunculaceae

Peony

Paeonia anomala

Height to 3 ft. Flowering stem usually flowered. Leaves twice-divided, with segments slender, pointed, smooth beneath and sparingly hairy above, abundant, forming a rather compact lump. Roots tuberous and not reaching by stolons near surface as does *P. tenuifolia*. Herbaceous.

Native of northern Europe and Asia. *P. officinalis* with crimson to white flowers and *P. albiflora* with white or pink flowers have leaves whose segments are not narrow. *P. anomala* with crimson flowers and *P. tenuifolia* with crimson to purple flowers have leaves with narrow segments, the latter not so arrowed and pointed at end as the former.

Flowers to 6 in. across, showy. Sepals, 5, persistent. Petals, 5-10, but much more numerous in cultivated forms. Stamens many, not conspicuous. Carpels on a fleshy disc containing large seeds. Cultivation has improved coloring of peonies and multiplied showy forms. In this species, fruits are reddish, in variety *insignis*, fuzzy.

Roots planted to depth of about 2 in. to avoid frost heaving and to ensure flowering. Transplanting should be avoided but may be done in September in rich soil; roots should not be in contact with manure. Tops should be collected and burned in autumn to avoid disease. Bad bud rot, sometimes serious.

Disease may be controlled by bordeaux spray in early spring and continued once a week for a month. Fertilizer may be a dressing of bone meal and deep manure in spring. Mulch may prevent frost from heaving roots out of ground but usually this is not necessary in old established plants. The "pinky" a symbol of early American garden.

Wild Columbine, Honeysuckle

Aquilegia canadensis

Height to 2 ft. or more. Open, branching habit, usually smooth. Leaves 2-3 times compound, 4-8 in. broad, with leaflets to 2 in. broad, those at end being without stalks. Lower leaves on long stems. Lower side of leaflets paler than upper surfaces. Root system long, coarse, and tough.

Common in rich woodlands and in loose soil in gorges and on wet cliffs. Sometimes rather abundant even in fields. Ranges from Nova Scotia to Northwest Territory area and south to Texas and Florida and in Rocky Mountains. Found at 5,000 ft. elevation in Virginia.

Flowers scarlet and yellow, nodding, 1-2 in. long, with nearly straight spurs, each to $\frac{3}{4}$ in. long and tipped with nectar gland. Sepals, 5, drop off early. Stamens numerous, often with tips turned back. Pistils, 5, each splitting down side to free many seeds. Flowers April through June. Pollinated by moths and butterflies.

Has many common names such as rock lily, jack-in-trousers, bells, meeting-house, clucky, and honeysuckle. It is of course not at all related to the woody plant known as honeysuckle. A number of related garden species, some of them with blue flowers and usually with larger flowers.

State flower of Colorado. Flowers are so beautiful and wilt so quickly that there is no reason why plants should be collected for bouquets particularly since plants are usually badly torn by ruthless collectors. Interesting to watch way pollination is effected.

Garden Columbine

Aquilegia caerulea

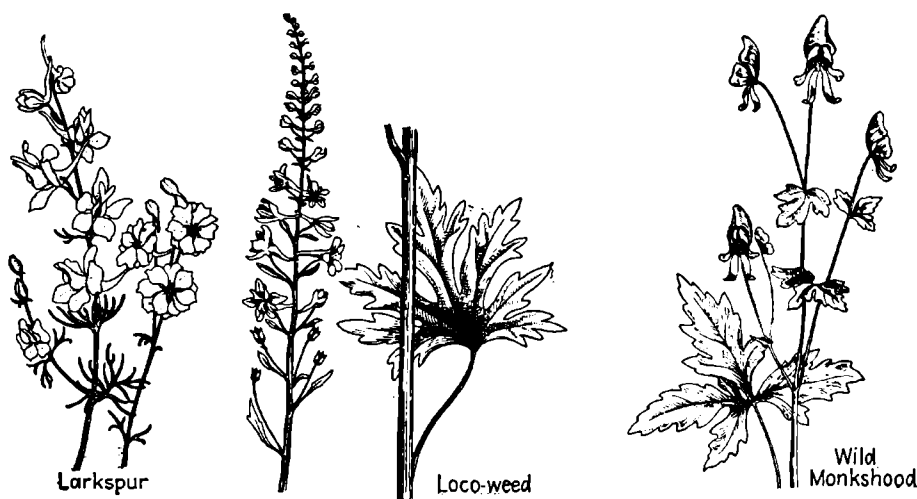
Height to 3 ft. Smooth below, but slightly fuzzy above. Basal leaves divided into 2's, smooth above and somewhat fuzzy beneath, or rather with a grayish bloom on the lower surface. Substantial root system of the usual herbaceous perennial.

This species native of Rocky Mountains. To 50 species found in north temperate regions, of which this is probably basis of most of blue garden columbines. Other types are known as chrysantha and the Canadian to garden trade and are kinds most frequently recommended for garden use.

Flowers to over 2 in. across, blue and white with spurs not curved inward or hooked at tips and with flowers in this species erect and not nodding. Sepals to $1\frac{1}{2}$ in. long, deep purple. Petals white, with pale blue spurs, to about 2 in. long. Stamens not protruding from flower. Fruits about 1 in. long, curved.

Seeds sown 1 year develop into plants that should bloom next and should increase in size from then on. Since plants cross, it is best to destroy those that are not desirable so that future seedlings from stock may be as wished. Recommended that plants be bought and in this way good stock be assured.

Native State flower of Colorado. Other relatively common garden species include those from Japan (incurved spurred) *A. flabellata* and *A. glandulosa*, *A. siberica* of Siberia, common *A. vulgaris* of Europe and Siberia, and straight-spurred *A. formosa* of our West Coast and Siberia, *A. skinneri* of Mexico, and *A. chrysantha* of our West.



PHYLUM SPERMATOPHYTA. CLASS DICTYOLEDONEAE
Order Ranunculales. Family Ranunculaceae

Larkspur

Delphinium sp.

Four common cultivated larkspurs are recognized: annual rocket, *D. ajacis*; annual branching, *D. consolida*; perennial rocket or candle; and perennial branching or bouquet. Wild tall larkspurs grow to height of 8½ ft., while low wild larkspurs rarely exceed 1 ft. The perennials may have stout root systems.

Native species in eastern and in western North America. Low larkspurs are found from sea level to 10,000 ft. elevation while tall larkspurs are best above that elevation. Low grow well in open exposed places while tall species favor moist habitats. Garden larkspurs come from many ancestries. Over 250 species.

Flowers showy, commonly blue but may be white, pink, or other colors. Sepals, 5, colored, one prolonged to rear into a long spur close to spurs of upper pair of petals. Stamens many. Carpels of pistil, from 1-5, splitting when ripe to free seeds. Chinese larkspurs among perennials that flower first year.

Seeds long known to be poisonous. Plants, if grazed by cattle, may in many species be poisonous. While plants are most attractive for bouquets and as garden flowers, cattlemen recognize them as among their worst enemies. Strange to say, plants that are poisonous to cattle may be harmless to sheep and horses that may graze them.

In common garden parlance, the name larkspur is applied to annual delphiniums while delphinium is reserved for the perennials. Many varieties of colors and of single or double forms have been developed for gardens. Seeds sown early develop into plants that should be thinned to 1 ft. apart.

Locoweed, Poison Larkspur

Delphinium glaucum

Other locoweeds include *Oxytropis lambertii*, *Astragalus mollissimus*, and *Astragalus diphysus*. Larkspurs poisonous to cattle are rivaled only by the above. This is a tall larkspur with almost smooth stems and is by some considered a variety of *D. scopulorum*, the other most common variety being *subalpinum*.

Found mostly in higher areas ranging from Alberta in Canada south through Washington and Oregon to Nevada and California. Closely related species, of similar effect, extend range of poisonous larkspurs east through Colorado, Wyoming, Idaho, and Utah for tall species and to Pennsylvania, Virginia, and Georgia for low species.

Flowers essentially as those described for the garden larkspur. Pollination in most delphiniums is by bumblebees, honeybees and bee-like flies with tongues suited for collecting hidden nectar. Seeds of difficult species vary considerably in size but most are considered to be poisonous.

Poisoning of cattle caused by grazing just after snows have left. Sheep may be poisoned by overfeeding on some young plants. Poison is due to alkaloids delphinoidine, delphisine, delphinine, and staphisagrine, of which the most virulent is delphinine. The alkaloid deltaline is reported in one species.

Symptoms of larkspur poisoning are staggering gait, loss of appetite, rigid extension of limbs after falling, constipation, nausea and bloating. In general, the practice of control has been to graze with sheep where species are not injurious to them.

Wild Monkshood

Aconitum uncinatum

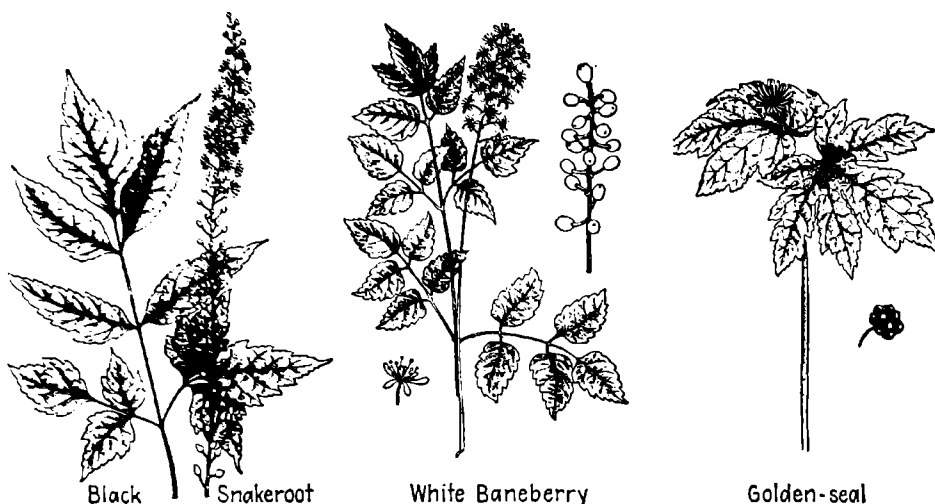
Height to 4 ft., climbing or turning upward. Leafy, slender. Leaves thick, alternate, broader than long, to 4 in. wide, with 3-5 deep clefts almost to the center, smooth or nearly so. Root substantial, normally poisonous if eaten.

Found in woodlands from southern Pennsylvania to Georgia and west to Wisconsin and Kentucky, reaching an elevation in Virginia of 3,000 ft. Related species extend range of genus into Canada and to West Coast among these being introduced *A. napellus* and yellow-flowered *A. Intescens* of West.

Flowers blue, with a cone-like, slightly beaked hood, to 1 in. broad or larger. Sepals, 5. Upper petals, 2. Pistils, 3-5, with pods being several-seeded and to nearly ½ in. long, beaked and spreading outward at tips. Drug aconite comes mostly from European plant.

Flowers, seeds, and particularly roots yield aconite depending in part on climatic conditions. Poisons are alkaloids aconine and aconitine that affect horses and sheep, causing muscular weakness, bloating, impaired breathing, altered pupils, and difficult but urgent swallowing.

Cure for poisoning includes digitalin or atropine injections or inhaling of ammonia or camphor fumes or both. Seeds sown in fall in well drained loam yield roots ready for harvest by plowing the second season after the flowering stems have died. Harvesting is in fall but European production rivals American.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Ranunculaceae

Black Snakeroot
Cimicifuga racemosa

Height to 8 ft. Leaves most abundant at top. Leaves thrice-divided and in three main parts, broad, forming a great flat, open, fan-like structure. Leaflets sharply toothed, thickish, nearly smooth, light green. Rootstock large and thick.

Found in woodlands from Maine to Georgia, west to Missouri, Wisconsin, and Ontario rising in North Carolina to 4,000-ft. elevation. Related heart-leaved snakeroot has a more limited range within that of this species.

Flowers borne along graceful frond that is to 3 ft. or even more long. Flowers appear as feathery tufts of white, petals appearing to be like stamens and stamens being numerous. Fruit berry-like and purple. Flowers have a most offensive odor in contrast with their general attractiveness.

Flowers appear in June through August. Scientific name means drive bug away, the *cimex* referring to *Cimex* the bedbug. Whether plant is an effective deterrent to these animals may be doubtful. Pollination effected by green flesh flies attracted no doubt by odor.

In spite of its offensive odor, plant is often grown as an ornamental because of beauty of graceful tall flowering stalk. It does reasonably well in a wild-flower garden, but is best placed well back from the path where it may be seen but not sniffed.

White Baneberry
Actaea alba

Height to 2 ft. Bushy, branching. Leaves thrice-divided and of 3 major parts with the lobes of the white species more sharp and more numerous than in the red, widely spreading and relatively few. Rootstock substantial and virulently poisonous if eaten.

White baneberry found in woods from Nova Scotia to Georgia, west to Missouri and Minnesota, rising in Virginia to 5,000-ft. elevation. Red baneberry ranges from Nova Scotia to Pennsylvania and west to Nebraska and South Dakota. *A. arguta* and other species extend range to west.

Flowers borne on short stems from top of flowering stalk. Petals shorter than stamens. Fruits white, berry-like spheres, with dark-purple ends resembling doll's eyes. In red baneberry, berry is red; in white, supporting stems may be red though this is not always the case. Flowers April through June.

Pollination by small bees especially of genus *Halictus*. Berries may provide food for caterpillar of one of azure butterflies. Flowers provide pollen, not nectar to visiting pollinators. Poison affects heart and is known to be fatal to children who eat berries.

Rootstock poison is violently purgative and emetic. Eating a few berries may cause increased pulse, colic, dizziness, and general sickness. Common names of white baneberry include necklace-weed, snakeroot, and white beads, while red is known as poisonberry, rattle-snake-weed, herb Christopher, and grapewort.

Goldenseal, Orangeroot
Hydrastis canadensis

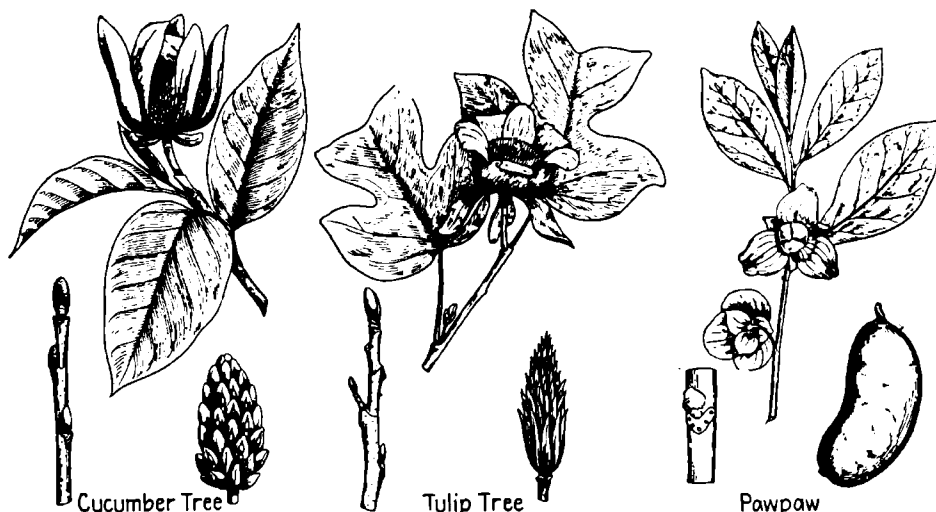
Height about 1 ft. Leaves, a single leaf from base and a pair of smaller leaves on flowering stem. Basal leaf with long petiole, to 8 in. wide, 5-9-lobed, lobes being broad but sharply toothed. Stem leaves borne at or near top, upper being just below flower. Rootstock thick and yellow.

Found in woods from Connecticut to Georgia, west to Missouri, Kansas, Minnesota, and western Ontario, reaching an elevation in Virginia of 2,500 ft. Rather extensively cultivated as a drug plant and as such is found outside normal range even to Pacific Northwest. A shade lover.

Flowers solitary, at end of flowering stem, greenish-white, to about $\frac{1}{4}$ in. across. Sepals, 3, dropping off soon. Petals, none. Stamens, numerous. Carpels, over 10, each supplied with 1-2 seeds and becoming grown into a fleshy, red berry, at maturity to $\frac{3}{8}$ in. through.

Poisonous or medicinal elements are alkaloids berberine, hydrastine, and canadine, of which hydrastine is most active. Poisons cause ulcers and catarrhal mucous inflammations. Grown under shade in woods well-supplied with leaf mold, with bone meal, cottonseed meal, and potash added as fertilizer.

Seeds are sown in fall but must not be allowed to dry. Started in sand layers after fruit pulp is removed. Seedlings are transplanted into lath houses and roots are ready for harvest in 4 years. Costs about \$2,000 to establish an acre plantation of goldenseal but domestic market of 300,000 lb. annually is sustained.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Magnoliaceae

Cucumber Tree, Magnolia
Magnolia acuminata

Height to 100 ft. or more. Diameter of trunk to 4½ ft. Trunk straight, and only slightly ridged. Twigs relatively coarse and weak, with alternate buds. Leaves to 10 in. long and to 6 in. wide, pointed at tip, with unbroken margin. Roots deep, spreading.

In moist, fertile, loose, deep soils growing with other hardwoods such as white oaks, ash, black gum, beech, tulip, poplar, and hickory. Ranges from New York and Ontario south to Georgia and west to Mississippi, Arkansas, Missouri, and Illinois, being found in Virginia up to 4,200-ft. elevation.

Flowers greenish-yellow, to 2 in. high, with petals much longer than sepals that quickly drop off. Stamens, many. Pistils form a cone-shaped or cucumber-like fruit to 4 in. long and 1 in. through that becomes rose-colored when ripe and frees ½-in. red seeds suspended on slender threads.

Wood weighs 29 lb. per cu. ft. Heartwood yellow-brown. Sapwood lighter in color. Growth relatively rapid as tree reaches maturity in 80-120 years. Wood has much same uses as that of tulip poplar. Tree not sufficiently abundant to be commercially important.

Related magnolias are well-known for brilliant or large showy flowers and this of course places them among ornamentals. Some have flowers appearing before leaves, which adds to their attractiveness. Trees are clean and therefore relatively popular as shade trees.

Tulip Poplar, Yellow Poplar
Liriodendron tulipifera

Height to 200 ft. but average about 100 ft. Trunk diameter to 12 ft., but average about 4. Bark ash-gray, uniformly furrowed. Twigs coarse, relatively weak, with diaphragmed pith. Buds large, look like a duckbill. Leaves smooth, dark-green, to 6 in. long, with 2 basal and 2 terminal lobes. Roots deep, spreading.

In relatively dry woodlands, usually on hillsides. In wild, with black cherry, white pine, white oak, chestnut, hickory, black walnut, basswood, white oak, butternut, and magnolia, not commonly in pure stands. Ranges from Rhode Island to Florida, west to Mississippi and Michigan. Known from Cretaceous times.

Flowers greenish-yellow, to orange within, to 2 in. high. Petals, 6, to 2 in. long and erect or curving upward, with 3 sepals recurving downward. Stamens many, with slender anthers. Pistils form erect, relatively dry cone to 3 in. long and nearly 1 in. through from which winged units are freed.

Wood uniform, greenish-gray to pale yellow, or brown with sapwood nearly white; weighs about 26 lb. per cu. ft. About 2-15% of seeds fertile. Maturity reached in 200-250 years though 300-year-old trees are known. Trees may be transplanted in spring if roots are not allowed to dry. Intolerant of oaks.

Desirable ornamental if grown with other trees away from strong winds. Wood known as "whitewood" and a valuable cabinet wood. 12,000-14,000 seeds per lb. Seeds eaten by bobwhite, white-tailed deer, red squirrel, cottontail rabbit. Recommended for growth in ravines as future timber and as soil anchorage.

Pawpaw
Asimina triloba

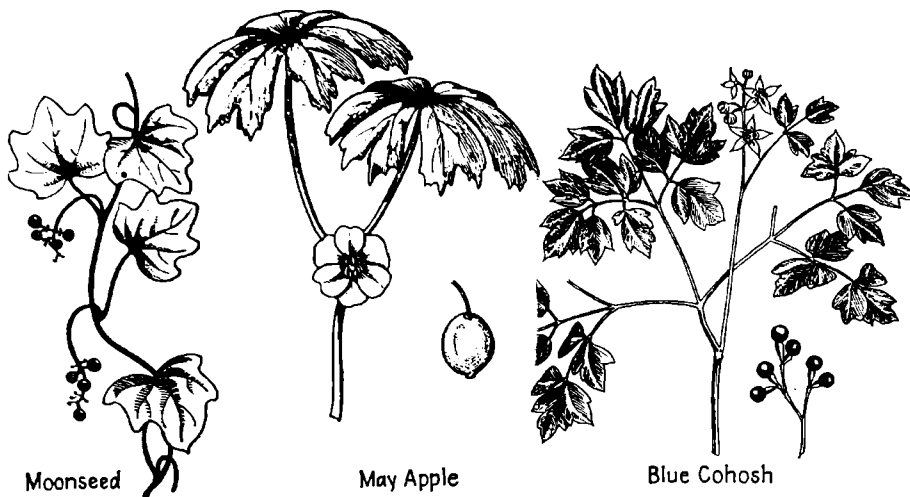
Tree to 45 ft. high, with trunk to 10 in. through. Often grows more as a shrub than as a tree. Young shoots and leaves dark fuzzy, becoming smooth when mature. Leaves to 12 in. long, with petioles to 6 in. long, rounded or pointed at base, pointed at tip and with unbroken margins, alternate. Buds naked.

Relatively common along streams from southwestern Ontario and western New York south through Pennsylvania and western New Jersey to Florida and west to Texas, Kansas, and Michigan. About 7 species related to this one in eastern and southeastern North America.

Flowers on shoots of preceding year, appear with leaves, to 1½ in. across, dark-purple. Petals, 6, in 2 series, the outer being much larger and more spreading. Sepals to ½ in. long. Stamens, numerous. Fruit a fleshy berry, to 7 in. long, 2 in. thick, brown, sweet, and edible, borne in clusters.

Wood to 24 lb. per cu. ft., not of great commercial importance. Seeds 1,200 per lb., with 50% germination and about 250 plants to be expected from 1 lb. of good seed. Few insect enemies, though a moth injures flowers and fruits in some areas rather seriously. Flowers in March and April, fruits in October.

Known as fetid shrub and custard apple. Fruits best after they have been frost-bitten but even then not liked by everyone. Some persons develop an unpleasant dermatitis from handling fruit. Recorded that members of Lewis and Clark expedition were saved from food shortage by abundant pawpaws found on return journey.



Moonseed

May Apple

Blue Cohosh

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ranunculales

Family Menispermaceae

Moonseed

Menispermum canadense

A slender, twisting, climbing vine, to 12 ft. long, smooth or slightly fuzzy. Leaves alternate, heart-shaped, to 8 in. wide, to 4 in. long, with unbroken margins, a short, pointed tip or sometimes with 3-7 lobes. Stems woody, slender, without stipules or stipule scars. May spiral around woody plants, eventually strangling them.

Found in woodlands and along streams from western Quebec south to Georgia, west to Nebraska, Arkansas, and Manitoba ascending in Virginia to 2,600-ft. elevation. Family is most abundant in tropical regions; 3 small genera represented in flora of eastern United States.

Flowers white, small, to $\frac{1}{4}$ in. across, in loose, open clusters. Sepals 4-8, in two series and longer than the 6-8 petals. Stamens, 12-24. Pistils develop into fleshy, bluish, globular, stone-centered fruit, to $\frac{1}{3}$ in. across and with stone spirally curved. Fruits resemble small grapes but should not be treated as such.

Flowers from June through July. Sharp edges of pits when eaten may cause mechanical injury to intestines. Probably some poisonous properties to fruits just as bitter poisonous alkaloids are known to be found in good-sized rootstock. Resemblance of fruit to grapes is unfortunate.

Plant may be considered as a rather attractive wild climber but doubtful if it should be encouraged in gardens or where children might mistake the fruits for grapes.

Mandrake, Mayapple

Podophyllum peltatum

Height to 18 in. Erect, rather brittle stem bears 1-3 large, umbrella-like leaves that are 5-9 lobed with defts sometimes almost reaching center and being nearly 1 ft. across; much lighter green beneath, smooth or nearly so. Rootstocks stout, horizontal, bearing clusters of radiating roots.

Common in moist woodlands, ranging from Quebec and southern Ontario to Florida and west to Texas, Kansas, and Minnesota, being found up to 2,500-ft. level in Virginia. Varies greatly in abundance through range. In some places, is conspicuous along railroad rights of way but probably equally so along other woodland borders.

Flower a single, beautiful, white, saucer-shaped flower borne at top of flowering stalk usually between 2 leaves. It is considered ill-smelling by some. Petals, 6. Stamens 12, bearing abundant, yellow pollen. Fruit a yellowish or brown succulent berry that is to 2 in. long. Flowering time May.

Pollination by bumblebees and other bees though some believe it may be self-pollinated. Rootstocks may cause severe dermatitis if handled by some. They contain poisonous, resinous podophyllin that is used medicinally as a purgative but that used in excess may be fatal.

Plant has some commercial value as a drug producer. DeWitt Clinton wrote of probable sale of ripe fruits in markets of New York after opening of Erie Canal, "Clinton's Ditch," but that one dream of his did not come true. Ripe fruits may be used in preserves but green fruits should be avoided always.

Family Berberidaceae

Blue Cohosh

Caulophyllum thalictroides

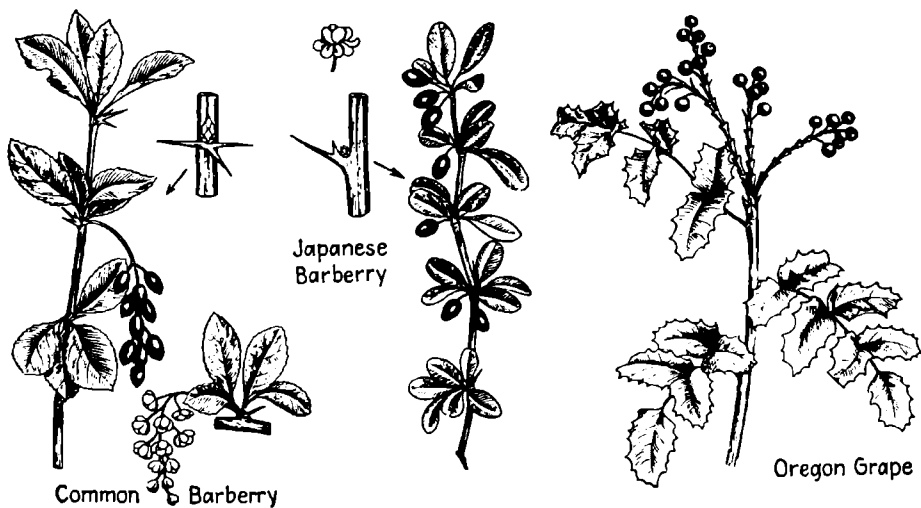
Height to 3 ft. Smooth, slender, blue-green herb, the erect stem bearing a large thrice-compounded leaf that in early season is conspicuously blue-green to purple. Stem arises from coarse, knotty, rather thick rootstock that bears scars of previous years' growth.

Favors moist rich woodlands with deep soil in woodlands. Ranges from New Brunswick to South Carolina, west to Missouri, Nebraska, and Manitoba, being found up to 5,000-ft. elevation in North Carolina. A native of region it now occupies. Usually associated with plants of mixed hardwood forests.

Flowers to $\frac{1}{2}$ in. across, greenish-purple, borne in terminal clusters. Petals, 6, and smaller than and opposite to sepals. Stamens, 6. Pistil matures before stamens, and is short. Pollination by bumblebees and other bees. Fruit looks like blueberries, to $\frac{1}{2}$ in. through and borne in loose, open clusters. Flowers in April and May.

The rootstock contains a bitter, poisonous alkaloid, methyletylsine, and certain glucosides. Because of bitter taste of leaves, plant is probably avoided by cattle and other grazers. No one should try to eat berries, which appear attractive enough but are highly irritating to mucous membranes.

Some people are susceptible to properties in leaves and may develop a dermatitis from such experience. Well-known and has such common names as papoose root, blue ginseng, squawroot, and blueberry. The scientific name of the genus means stem leaf.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ranunculales. Family Berberidaceae

Common European Barberry
Berberis vulgaris

Shrub to 8 ft. high, with arching branches and drooping ends. Twigs gray with rough bark, armed with 3-parted spines at bases of alternate leaves. Leaves to 2 in. long, with margins bristly notched, clustered on older portions of shoots. Roots relatively deep, tough, and yellowish-wooded.

Naturalized from Europe and Asia, widely established as an ornamental and as an escape through southern Canada and the United States, being common in thickets and in waste places, sometimes grown as a hedge because of the spines that provide an excellent barrier.

Flowers in drooping, many-flowered clusters that are to 2 in. long, individual flowers being yellow, to $\frac{1}{4}$ in. long, with disagreeable odor and with 6 petals and 6 stamens, the last being sensitive to touch at the base. Fruit a scarlet, oblong, juicy berry that is sour but edible.

Flowering time May and June, fruiting time from September on. Plant is intermediate host for wheat rust, bearing aeciospores in characteristic cups on underside of leaves. From these spores may develop structures that cause wheat rust on wheat. Fruits eaten by grouse, pheasant, quail, and other birds.

Popular as an ornamental in regions where wheat growing is not important. Berries make excellent preserve or jelly or may be made into delicious pies. Young leaves have pleasing sour taste and juice mixed with other fruit juices makes a good drink. Juice alone with sugar makes good jelly. Yellow dye from root bark.

Japanese Barberry
Berberis thunbergii

Shrub, to around 4 ft. high, with dark, tough stems well-armed with spines that are sharp, stiff, and more or less simple. Leaves dark-green, with unbroken margins, to 2 in. long but normally smaller, with relatively constricted bases. Roots tough but relatively shallow, withstand abuse of frequent and careless transplanting well.

Does best on well-drained, sunny hillside but grown most frequently along borders of buildings, paths, and the like. Native of Japan but has become widely naturalized in many parts of United States and may be found at considerable distances from communities. Found in many cultivated varieties.

Flowers borne singly rather than in clusters as in European barberry. Flowers yellow, shallow cups, with a broad pistil in center surrounded by stamens that respond readily to touch and reach over, touching the pistil. Fruits an oblong, scarlet berry.

Competes poorly with grasses and may succumb to drought. Branches root freely where they touch ground. Plant not attacked by wheat-rust fungus. About 25,000–28,000 seeds per lb. with a germination of 80%, 1 lb. of seed yielding normally about 4,000 usable plants. Berries that are hard in fall become softer through the winter months.

One of most popular and hardy of low ornamentals. Fruits known to be eaten by pheasant, grouse, bobwhite, and other species of birds and by cottontail rabbit. Provides good cover and food for many useful small forms of wildlife and roots serve well as soil anchor for controlling erosion.

Oregon Grape
Berberis aquifolium

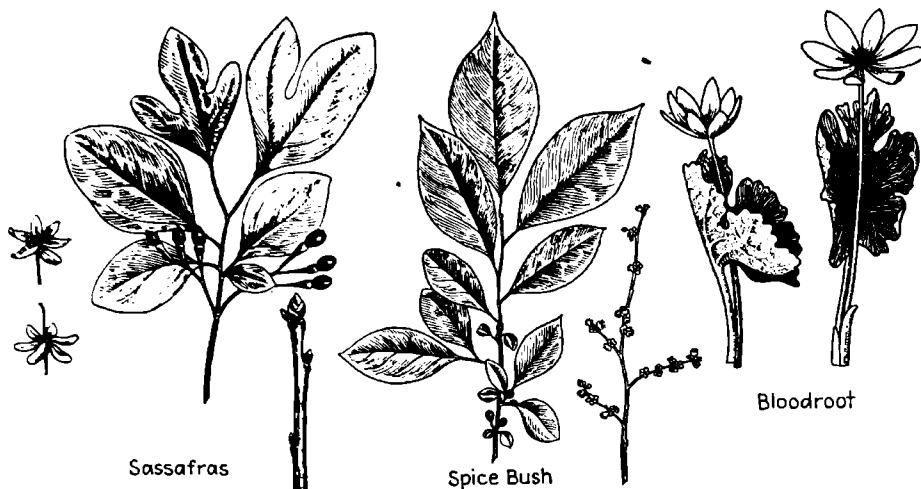
Height to 6 ft. Evergreen shrub, with compound, holly-like, evergreen leaves whose 5–9 leaflets are to 4 in. long, dark, shining green above, and lighter beneath with coarse, bristle-tipped scallops along the margins. Branches are unarmed.

Ranges from British Columbia, south through California, growing along roadsides and as undergrowth at edges of wooded areas. Also grown as ornamental widely, with many horticultural forms developed, some with variegated leaves. Some 45 species native of North America, Central America, and eastern Asia.

Flowers, many, in a cluster arising from axils of leaves, clusters being erect in this species and relatively compact. Sepals, 9. Petals, 6, with basal nectaries yellow. Fruit a dark blue, relatively small berry. Flowers in evidence in May and fruits in late summer and fall.

Favors humid soil, sheltered from strong winds and direct sunlight. Usually transplants easily. Commercial propagation by means of seeds sown soon after they mature, or stratified in sand and sown in spring, or by cuttings of half-ripened wood in greenhouses or by means of abundant suckers in some species.

Plant is popular as an outdoor ornamental in regions where weather conditions are not too severe for its survival. Superficially it gives effect of a blue-berried holly though it is not closely related to holly species. It is the State flower of Oregon.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ranunculales
Family Lauraceae

Order Papaverales
Family Papaveraceae

Sassafras

Sassafras albidum

Tree reaches height of 125 ft. Twigs rubbery, often bright green or reddish-brown and, when mature, shining. Bark of young stems thin, reddish-brown; of old trunk, to 1½ in. thick, with deep, irregular fissures. Leaves highly variable, of 1, 2, or 3 lobes, to 6 in. long and 4 in. wide and red, yellow, or orange in fall.

Found in dry, sandy soil from Maine to Florida and west to Texas, Iowa, Michigan, and Ontario but frequently suffering badly from winterkilling in the northern part of the range. May form considerable thickets and frequently produces suckers.

Flowers to ¼ in. broad, in loose, open clusters, with stamens equal to calyx segments and ordinarily opposite them. Fruits appear at ends of thickened stems and are bright blue but when immature surrounded by remains of scarlet calyx, to ½ in. long.

Wood soft, brittle, weak, brown, coarse, but light-colored in sapwood, weighs 31 lb. per cu. ft. Bark of roots particularly rich in aromatic oil that gives plant its character. Wood may be used for fence posts, rails, and in cooperage but bark has a more popular use.

Bark stripped from young roots may be used fresh by boiling to make delicious tea or may be dried to be used later. With sugar flavoring, it is delicious. Oil is used in flavoring candies, tobacco, gum, soaps, perfumes, and medicines and is one of sources of artificial heliotrope. Oil most commonly found in all bark and in pith.

Spicebush

Lindera benzoin

Shrub to 15 ft. high, nearly smooth, with greenish, spotted, rubbery twigs that are highly aromatic. Leaves alternate, entire, slightly hairy beneath, relatively thin, to 5 in. long and all parts fragrant when crushed. Whole plant appears to branch grotesquely but attractively.

Found in moist woodlands, thickets, and by streams or sometimes planted as ornamental ranging from Maine to North Carolina and west to Tennessee, Kansas, Michigan, and Ontario ascending in Virginia to 2,500-ft. elevation. Not closely related to plant *Syrax* that produces benzoin of commerce.

Flowers yellow, appearing before leaves, fragrant, to ⅛ in. across but in clusters that give a larger effect. Some flowers staminate, some pistillate; on separate bushes or some with both stamens and pistils. Sepals, 6, dropping off early. Stamens, 9. Fruit oval, red, stoned, fleshy, aromatic.

Bark and fruit most commonly used as source of aromatic, tonic, astringent oil that has some reputed medicinal properties; certainly it is pleasing to sense of smell. Flowers appear in March to May and fruits from August through September. In autumn, plant has attractive, clear yellow leaves.

Woodsmen welcome plant when building fires since it is one of few plants whose wood will burn well while still green. It bears common names of snapwood, benjamin bush, wild allspice, and spicewood as well as spicebush. There are at least a half-dozen other species known from different parts of the world.

Bloodroot

Sanguinaria canadensis

Height to about 2 ft. Smooth, with leaves apparently coming from ground. Petioles to 14 in. long. Leaf blade to 1 ft. broad and 7 in. wide, 5-9-lobed, with conspicuous cleft at free end. Leaves curved with underside outermost. Rootstock thick, juicy, red, horizontal.

Found in rich woodlands from Nova Scotia to Florida and west to Alabama, Arkansas, Nebraska, and Manitoba, ascending to 2,500-ft. elevation in Virginia, sometimes surviving after woodlands have been cut but ordinarily disappearing when too exposed to sun.

Flowers borne singly at end of stem that exceeds leaves, white, to 1½ in. wide, rarely with 2 flowers to a stem. Sepals, 2. Petals, 8-16, shed easily and early, closing or opening on disturbance. Stamens, numerous, yellow. Fruit single-celled, narrow, of 2 parts to 1 in. long. Flowers April and May.

Red juice contains alkaloid sanguinarine which is toxic and in overdoses may be fatal, causing vomiting, a burning sensation in mucous membranes, faintness, vertigo, and death due to paralysis of the heart. Some commercial value for the drug but it is negligible.

One of most popular spring flowers but also most disappointing because while flowers look attractive before they are picked, they almost immediately close or lose their petals and must then be discarded. Plants may be set out in wild-flower gardens and in proper soil succeed in giving showy white flowers early in season.



Celandine



Oriental Poppy



California Poppy

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Papaverales. Family Papaveraceae

Celandine

Chelidonium majus

Height to 2 ft. Weak herb with a pungent yellow juice, sparingly hairy. Leaves to 8 in. long, thin, almost twice compounded, with segments usually rounded or lobed. Leaf bases expanded and sometimes partly clasping stem. Veins in leaves conspicuous and relatively large.

Naturalized from Europe but established well from Maine to North Carolina, west through Pennsylvania and Ontario. Common along roadsides and steep embankments, in rather shaded damp waste places, or sometimes in woods or at their edges.

Flowers to $\frac{3}{4}$ in. across, in loose open clusters that arise from axils of leaves on slender yellow stems. Sepals, 2. Petals, 4. Stamens, many. Fruit an elongate, almost linear but coarsely roughened capsule that frees many shining smooth crested seeds. Flowers from April through September.

Juice and other parts of plant contain alkaloids chelidoniumine, protopine, and chelerythrine and may be used with care as a purgative or as a diuretic. Juice may poison skin of some individuals so children should be discouraged from painting themselves with it.

In spite of poisonous properties, plant is useful as an ornamental. It requires little care and once established maintains itself. Grows in areas not suitable to some other species. Known as tetterwort, killwort, wartwort, and swallowwort.

Oriental Poppy

Papaver orientale

Herbaceous perennial that reaches a height of to 4 ft., appears to be stout, and is well covered with stiff hairs. Leaves to 1 ft. long, deeply cut into sharply toothed or lobed segments that are relatively narrow and uniform and usually pointed at free end.

A native of Mediterranean region east to Persia. Widely grown in gardens as ornamental. Other ornamental poppies include Iceland poppies *P. nudicaule*, Shirley poppy *P. rhoeas*, and the opium poppy *P. somniferum*. All are to be found in gardens in various parts of the world.

Flower to over 6 in. across. Petals, 6, broad at free end, narrowed at base, scarlet with black area at base. Stamens, numerous. Fruit a capsule to 1 in. long, with a row of openings along upper edge from which are shaken enormous numbers of small seeds. Some poppies annual but most biennial or perennial.

Opium poppy, which differs from Oriental in having clasping stem leaves, is source of opium of commerce, which is collected from milky juice found in unripe fruits. It is source of many alkaloids such as bitter, odorless, colorless morphine; bitter, odorless, colorless or white codeine, laudanine, narcotine, and protopine.

Opium juice is usually sedative. This plant has probably done much to shape world history, particularly in the Orient. Of use only in the garden, since flowers wilt quickly when cut, and the season is normally short. Massed in a garden with flowers of a single color effect is hard to beat.

California Poppy

Eschscholtzia californica

Height to 2 ft. Erect, spreading, or sprawling to form rather compact mats. Leaves long-petioled, alternate, divided into slender parts, those on stems being smallest and most slender. Plant pale green and smooth.

Native of California and Oregon but found wild from Lower California to Columbia River and east through Nevada, Utah, New Mexico, and Arizona. Escaped and naturalized in central Europe and grown rather widely as a hardy garden ornamental. About 100 species.

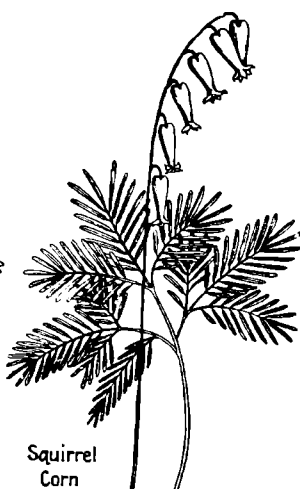
Flowers yellow to deep orange shallow saucers spreading to 3 in. wide when open and responding conspicuously to sun. Petals 4, inserted on receptacle with numerous stamens. Fruit a slender capsule to 4 in. long, that splits into 2 parts, freeing seeds.

A perennial grown largely as an annual, this species often blooming even after first killing frost. If protected in severe winters, plants may survive in North and give early flowers in spring. It selfsows and once established may prove reliable as a border plant where bright showiness is sought.

Chief use is as an ornamental. It is State flower of California. Plant was named after the Russian naturalist Eschscholtz, who found it in 1813 in great profusion on sand where San Francisco now stands.



Dutchman's Breeches



Squirrel
Corn



Bleeding Hearts

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Papaverales. Family Fumariaceae

Dutchman's-breeches *Dicentra cucullaria*

Height to 10 in. Leaves and flower stalks arise from a common point close to the ground. Plant delicate, immaculately smooth, and pale gray-green. Leaves slender-stalked with finely divided parts that may be almost linear. Underground parts bulbous but not like yellow tubers of squirrel corn.

Often very common in rich woodlands where there is deep leaf mold, but mostly over lime soils, surviving on more sterile soils than squirrel corn or growing with it. Ranges from Nova Scotia to Minnesota, south to Missouri, Kansas, and North Carolina. In Virginia found to elevation of 4,500 ft.

Flowers white, nodding on ends of drooping stalks, with 2 spreading trouser-leg-like spurs, usually with point of spurs uppermost. Flowers in April and May about 1 week before squirrel corn. Sepals, 2, scale-like. Petals make the "breeches." Stamens, 6, in 2 sets opposite outer petals. 1 pistil. Seeds, 10-20.

Has common name of little blue staggers, possibly referring to poisonous properties of leaves that include toxic alkaloid cucullarine. More concentrated in this species than in squirrel corn. May be fatal to cattle, effects appearing to 2 days after eating and including trembling, labored breathing, frothing, convulsion, glassy eyes, and even death.

A most attractive spring flower, harmless to the touch but not to be eaten. Normally not eaten by cattle if other more suitable food is available and does not last late into the season. Pollination by long-tongued bumblebees, shorter tongued honeybee visitors merely eating pollen but not reaching nectar. Worth protecting as a wild flower.

Squirrel Corn *Dicentra canadensis*

Herbaceous perennial. Leaves almost identical with those of Dutchman's-breeches though possibly with more white bloom on undersides. Leaves all basal and arising from buried rootstock that bears numerous clustered spherical orange tubers quite different from those found in Dutchman's-breeches.

Found in rich woodlands where soil is deep, from Nova Scotia to Virginia and west to Tennessee, Missouri, Nebraska, Minnesota, and Ontario, or slightly more restricted than Dutchman's-breeches. They may grow side by side in same woodland and often form considerable patches.

Flowers nodding, on short stems branching from a rather erect slender stalk that reaches a height of 1 ft., to $\frac{3}{4}$ in. long, broadest at base but without spreading spurs characteristic of Dutchman's-breeches, white or greenish-white, slightly fragrant. Inner petals more crested than those of Dutchman's-breeches.

Like Dutchman's breeches, leaves contain poisonous alkaloid cucullarine though not in such great concentration. Since this poison is also found in tubers, one should not experiment with eating them. Cattle may eat leaves when other forage is not available and become violently though not fatally ill.

Plant is attractive spring flower and worthy of protection. Best in its natural setting and so might well be left unpicked. However, picking only the flowers has little bad effect on the general economy of the plant.

Bleeding Heart *Dicentra spectabilis*

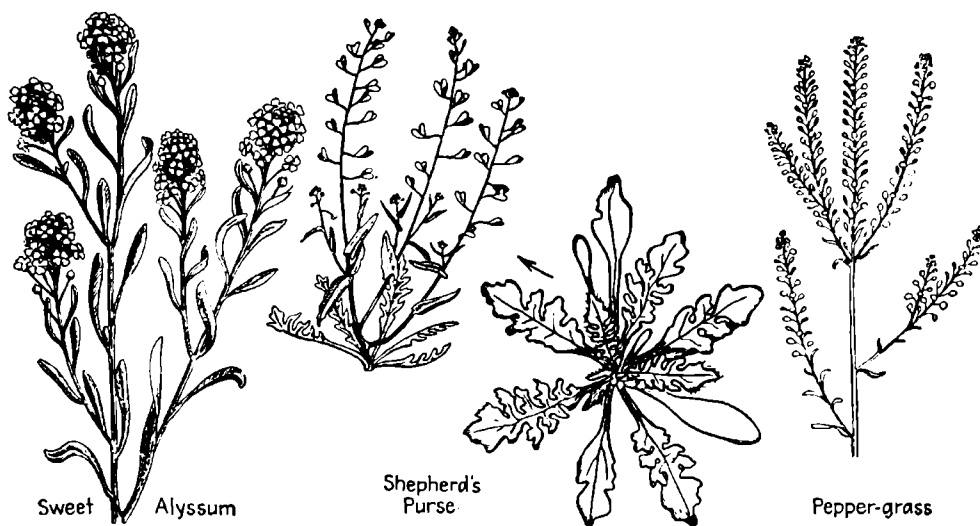
Height to 2 ft. Stems leafy, the leaves being alternate, apparently doubly compound or deeply cut, light transparent green and showing silvery under water; usually in shape of a broad fan. Substantial underground parts.

Native of Japan, where it was discovered in middle of nineteenth century by Robert Fortune and introduced into English gardens about 1847. Related to our native squirrel corn and Dutchman's-breeches, as should be evident from appearance of flowers and leaves. About 15 species of *Dicentra* in Asia and America.

Flowers like conventional red hearts, hence the name. In this species arranged along a single bending stem. Sepals, 2, small and scale-like. Petals, 4, with 2 outer spurred. Stamens, 6, in sets of 3. Pistil, 1, ripening into a 2-valved capsule that frees crested seeds when it breaks.

Prefers rich soil but does best when it is light. Propagation may be by separating the underground parts or by seed. Requires a good supply of moisture and if this is available may flower through summer. Young shoots normally appear in May but may be forced under glass to begin development earlier.

A most popular plant in old-fashioned flower garden. Children delight in pulling flower apart and giving parts names based on their shape, such as rabbits for the red outer petals, a harp, a pair of glasses, and a bottle—the pistil in the center.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Sweet Alyssum
Alyssum alyssoides

Stems sprawling, to height sometimes of 1 ft., weak and rising at tips but so numerous as to form a relatively compact mass. Leaves slender to narrow paddle-shaped, generally pale green and poorly covered with grayish hairs, giving plant gray-green appearance. Roots fibrous.

Native of Europe but widely grown in America and other parts of world where it favors loose rich well-drained soil. Also does well on compact soil. Related to golden tuft *A. saxatile* or madwort, known also as golden alyssum, with yellow flowers that appear as mats in spring.

Flowers white or pale yellow, with 4 petals which are little longer than 4 green persistent sepals. Fruit small and many-seeded. *A. saxatile* grows taller and forms larger head of flowers. Plants lend themselves readily to separation; hardy under such treatment.

Seeds sown in early spring indoors or out. Little plants transplanted to stand 1 ft. apart so that they will make matted rows of white or yellow flowers. If cut back after blooming, will show new growth and again bear flowers. Seeds may be sown at different times.

One of most popular and easily grown border plants. Related *A. saxatile* is perennial and popular where early yellow mat effect is desired along foundations of houses. Seeds sown in August should produce flowers in early spring. Once believed useful cure for hydrophobia.

Shepherd's Purse
Capsella bursa-pastoris

Herb. Height to nearly 2 ft., with slender tough sparsely leaved, openly branched stems commonly curving upward from leafy rosette. Leaves alternate, varying from slender upper clasping forms to rather deep-toothed basal ones. Root a deeply penetrating taproot.

Found in gardens, along roadsides, in waste places, usually where there is sun and where it is not too wet, often where ground is firmly beaten. Naturalized from Europe and widely established through America and in other parts of the world.

Flowers small and inconspicuous. Stamens and pistils about equal in length, permitting self-pollination when insects fail to visit. Flowers appear through most of year but are less conspicuous than 3-cornered flattened fruits. Fruits 2-celled and crowded with reddish seeds. Plant may produce 2,000 seeds.

Can withstand severe drying and cold and because of rapid growth quickly fills unoccupied ground. Seeds may remain vital and dormant although buried many years. Seeds or fruits may be eaten by birds. Whole plant may be eaten by chickens and by other animals. Many rosettes may survive winter.

Plant is common salad green but inferior to many others easily collected. Leaves may be boiled or eaten raw. Tender blanched leaves taste like cabbage and young plants make excellent sandwich filler. Hoeing cuts taproot. May be controlled by spray of iron sulfate or copper sulfate; plant cannot withstand much competition.

Peppergrass
Lepidium apetalum

Stems to 18 in. high, well-branched and spreading from a compound erect stalk. Leaves alternate, slender, usually toothed and nearly scentless but somewhat peppery to the taste. Root system a slender vertical deeply penetrating taproot with branches of minor size. Annual or winter annual.

Common along roadsides, in gardens, lawns, and waste places frequently where ground is hard-packed as on playgrounds. Most conspicuous in fall but may be found green throughout year. Ranges from Maine to Ontario and California, south to District of Columbia and Texas. Native of Eurasia and introduced comparatively recently.

Flowers inconspicuous, with petals usually lacking. Stamens, 2. Pistil, about length of stamens, which makes self-pollination a simple and effective matter. Seeds orange-brown, common as a seed impurity, expelled from fruit by an explosion. Flowers June through October. Seed to seed in a few weeks.

Not commonly found in shade or where there is too much moisture. Somewhat sticky seeds adhere to wet animals and take up water quickly when planted, thus getting a start on other plants. Low rosettes of many leaves may preserve some plants through winter. Acts as host plant in July and August for black cherry aphid *Myzus cerasi*.

Plant used occasionally as a salad. Seeds are used as a poor substitute for canary seed for feeding caged birds but do not induce desired behavior in such birds. Plants serve to slight extent as soil anchor in areas not occupied easily by most plants.



Radish



White Mustard



Field Mustard

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Radish

Raphanus sativus

Height of flowering stalk to 3 ft. Leaves stalked, roughened with sharp hairs, or smooth, with lateral segments paired, and terminal segment largest of all. Root thick, fleshy, variously colored depending upon variety, with a sharp taste which makes it delicious if it is grown rapidly. Annual or biennial.

Native of Europe and Asia, and under cultivation. Prized in days of the Pharaohs and ancient Greeks. Grown commercially in United States, particularly in California, Mississippi and other Southern states. Grown in most gardens for home consumption. Best in light soils.

Flowers white to lilac or blue, with 4 petals appearing after flowering stalk has developed and after root has stored its maximum of food reserve. Fruit about 3 in. long, rather spongy, contains 1-6 seeds; has rather long slender beak and does not split to free seeds naturally. Seed, round.

Roots may be ready for harvest 3 weeks from time seeds are sown. Best practice calls for several plantings at intervals of 10 days, so new fresh roots will be coming to maturity for home use. Winter varieties should be planted in late summer and may be stored for use in winter. When planted for commercial crop, rows are 12 in. apart; 12 lb. of seed per acre.

Where root maggots and aphids can be controlled and a quick growth can be guaranteed, radishes may make a good cash crop. They are tied in bunches of 6-12, shipped like spinach, while winter varieties are shipped like turnips with tops removed before they are put into storage. Slow-growing plants are tough and strong.

White Mustard

Brassica alba

Height to 6 ft. Stout annual, rather sparsely covered with hairs. Leaves oval in outline but usually deeply divided, even to midrib, into 1-3 pairs of notched, angled lobes. Stem leaves long-petioled. Upper leaves without petioles. Stem branched freely in upper parts.

Found in waste places widely distributed either as an established weed or as an escape from cultivation. Introduced from Europe and is a native of Asia. Essentially a plant of temperate parts of world. Not common in Southern Hemisphere.

Flowers yellow, to $\frac{3}{4}$ in. across, borne on rather stout stems, developing fruits that are slender, nearly round in cross section, tipped with long flat sword-like beak that may be as long as or longer than rest of fruit. Seeds found in a single row in cells and not winged or margined.

Seeds yellow on outside and white within; contain, among other things, a mucilage, some fixed oils, a glucoside (sinalbin), and proteins. White mustard seed has an oil content of from 26-30% as contrasted with 30-40% in black mustard. White mustard is not major source of table mustard.

Leaves used for greens. Ground seeds mixed with water and glucoside break down through activities of enzyme to yield nonvolatile sulfur compound. Used mostly as a medicine or condiment, oil as counterirritant (mustard plaster), lubricant, or illuminant. Popular mustard of England.

Field Mustard

Brassica kaber (arvensis)

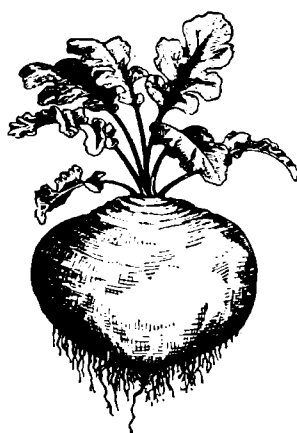
Height to 2 ft. Erect, annual, with spreading branches. Stems and leaves well-covered with bristly stiff hairs that may be scattered in some spots. Leaves highly variable but likely to lack extensive lobing and divisions found in most other closely related mustards; more lobed than cut to midrib.

Native of Europe and widely distributed as a common weed that has become naturalized in fields and in waste places. Grows too abundantly mixed in with more desirable plants and may have been introduced through use of poor seed.

Flowers yellow, to $\frac{3}{8}$ in. across. Fruit smooth or bristly, spreading or turning upward, with constrictions obvious around seeds, to $\frac{3}{8}$ in. long and $\frac{1}{12}$ in. wide, tipped with flattened, drawn out, sometimes 1-seeded beak that is to $\frac{1}{2}$ in. long. Conspicuous nerves on outside of fruit. Flowers from July through August.

Common mustard of grainfields. Disliked by most grain growers because of competition plant offers. Hairy surface makes it possible to use some sprays as a control and if these are properly applied they may be selective.

General control measures are careful inspection of seed to avoid its inclusion, spring weeding with harrow when drilled grain is about 4 in. high and sun is hot enough to kill injured plants, and hand pulling where this is possible, particularly before new seed crop is produced and freed.



Rutabaga



Rape, Colza



Black Mustard

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Rutabaga

Brassica napobrassica

Smooth biennial, much like turnip but with a more elongate root, denser flesh, and tubers tapering downward from lower half or third. Flesh usually yellow but sometimes white. Leaf-bearing crown with leaves like those of rape except that stem leaves are like those below but smaller.

Grown as a crop in most temperate zones where conditions are suitable. In Canada and England, known as "Swedish turnip" or "turnip-rooted cabbage." In northern United States grown most commonly as fall crop but may be grown also in spring.

Flowers much like those of cabbage except that stems bearing fruits are stout and spreading, rather than ascending, and beak of fruit rarely exceeds $\frac{3}{4}$ in. in length, instead of being slender. In fact, whole fruit of rutabaga is shorter and more compact.

For fall crop, plant seeds in midsummer preferably in deep fertile loam. In South, sow from July through September in rows 18 in. apart, thinning to about 6 in. apart to allow for normal root development. Will withstand slight freezing but should be harvested before hard freeze comes. Stores successfully in cool cellar.

Of excellent food value, containing 11% dry matter, 9.3% digestible nutrients, 1.3% protein, 1% digestible protein, and potassium, nitrogen, calcium, and phosphorus in smaller amounts and in about that order. In some regions rutabagas are grown regularly for feeding to livestock.

Rape, Colza

Brassica napus

Height to $3\frac{1}{2}$ ft., branching, purple at base, with leaves to over 1 ft. long and half as wide, mostly smooth though sometimes with stiff hairs sparingly placed. Lower leaves lobed and contracted to base into winged petiole. Upper leaves clasping stem with bases. Root, slender.

Common variety is dwarf. Annual type is grown for seed in Europe, India, and China. Biennial is commonly grown for forage or for human consumption in Europe and in America. Sometimes occurs as an escape from cultivation.

Flowers light yellow, to $\frac{3}{4}$ in. across, on slender spreading stems. Fruit to 4 in. long, with slender beak. Seed may be sown in Canada by June 15. In South, fall sowing is best. Seeds planted $\frac{1}{2}$ in. deep, broadcast, drilled in rows, or mixed with oats or other crops. Becomes bitter as plants mature.

When broadcast, 4 lb. of seed needed per acre; when drilled in 24-in. rows, 2 lb. will do. Sown with grain when grain is to 2 in. high and with corn at time of last cultivation. 1 acre can yield to 50 tons of green feed from rape but 10 tons is a better average.

Rape grown for seed for oil in Europe, India, and China. Good field of pasture rape can support 12 sheep per acre for 1 month or 24 hogs for same time. Cattle fed too much rape may bloat, and swine may have similar trouble. Salt should be available when rape is fed, and dairy cattle should be fed rape after milking rather than before.

Black Mustard

Brassica nigra

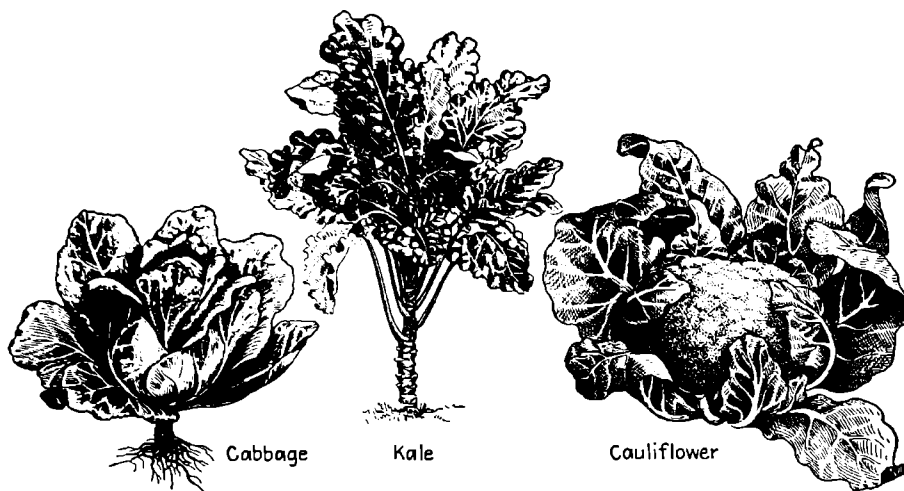
Height to 10 ft. Branches freely and widely, stems being rather coarse, almost smooth or with stiff hairs. Leaves highly variable, usually with stiff bristly hairs, lower ones not greatly developed but terminal lobe usually large, with margins notched or toothed. All leaves well-petioled.

Naturalized from Europe and escaped as a common weed except in Northwest. Native originally of Asia and grown rather extensively in California, England, Germany, Holland, Austria, and Italy, possibly the best coming from Trieste area.

Flowers bright yellow, to $\frac{1}{4}$ in. across, in twig-like open clusters crowned by unopened buds. Fruit under 1 in. long, tipped with a conic beak and closely pressed to supporting stem, 4-sided. Seeds dark-brown outside, yellow inside.

Chemical content much as in white mustard, but essential oil is most powerful and can blister the skin and injure membranes of eyes and nose. Fixed oil has a mild taste. Oil content of black mustard seed is 30-40%, or more than that of white mustard.

Leaves used for greens. Glucoside (sinigrin) from ground seeds yields volatile oil that gives fragrance and flavor to mustard used on table. Black mustard favored over white on European continent. Used in medicine, in soap making, in preparing sardines, pickles, salad dressing. Prepared for table use by adding salt and vinegar.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Cabbage

Brassica oleracea capitata

Leaves in center form compact head, leaves themselves up to 1 ft. across and nearly circular; the outer coarse, green, and more or less flat; the inner paler, more tender, and making the head. Varieties include Brussels sprouts, cauliflower, broccoli, and sprouting broccoli. Root relatively deep. Biennial or perennial.

Grows wild on chalky seacoasts of England, in Denmark, in northwestern France, and in Greece. It was introduced into cultivation in European gardens in ninth century. Known to history back to 2500 B.C. Favors a cool, moist climate, so in South is grown in winter. Has little soil preference but does best in sandy loams except in late summer.

Flowers in long clusters, whitish-yellow; flowers sometimes produced only in plants that have been subjected to low temperatures. Plants not cooled known to produce 3 heads in 1 year and 6 heads in 2 years. These plants then taken to a cool area produced flowers and seeds as would normally have happened. 2 months' cooling best.

In North, seeds sown in hotbeds in January, transplanted to 2 in. apart, then transplanted into field. For late crop in North, seed sown 6-8 weeks before transplanting. 1 lb. of seed provides for 4 acres if seedlings grown in greenhouse. Should be "hardened" to withstand temperature to 17°F. for short duration. Storage is most successful at 32°F.

Probably most important crop of genus *Brassica*. Grown in market gardens throughout United States, but winter production has increased greatly in South. States leading in acreage in prewar years were Texas, 36,000 acres; New York, 30,000; Wisconsin, 16,700; Pennsylvania, 10,500; and California, 8,200. Average price per ton about \$16. Shrinkage varies from 7-27% with temperature, ventilation, and time.

Kale, Borecole

Brassica oleracea acephala

Leaves thick but not crowded into compact heads as in cabbage or with other modified parts. Some kinds have cut or frilled margins while others are more regular in shape. General color blue-green. Kales probably more nearly like original wild form than are most other varieties. Giant kales 9 ft. high.

Found wild today on cliffs of southeastern England, so were probably developed from similar plants. Now grown widely where climate is suitable. Popular varieties include Scotch curled and Siberian. Many general types include tree kales, collards, and curled kales.

Flowers are, in essence, like those of cabbage and other close relatives. Seeds sown broadcast or in rows to 18 in. apart. For market use, plants are thinned to 6 in. apart, thinnings generally being used for home consumption. Clean cultivation essential to success in raising good kale.

Grown more in other countries than in United States. Good resisters of heat, cold, and drought. Frost improves flavor. Kale will grow in any type of soil but application of 20 tons manure to acre or 1,500 lb. of fertilizer of 4% nitrogen, 8% phosphoric acid, and 4% potash should give excellent results.

Kale is grown as winter crop in South and as late fall crop in North. In England, stout stems of tree kales are used for rafters and for canes. Kales are also known as borecole, cow kales, kitchen kales, and so on.

Cauliflower, Broccoli

Brassica oleracea botrytis

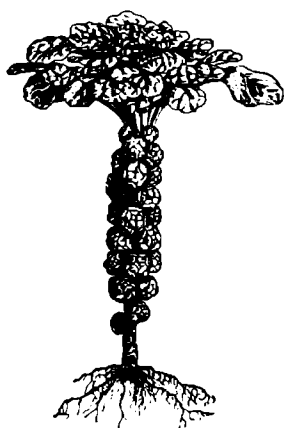
Low, with broad dense head grown over by leaves. Part that is eaten is really thick short stalks of undeveloped flowers and their supporting bracts. In a highly desirable cauliflower center is white. In broccoli heads are smaller, leaves larger, and whole plant greener.

In France and England broccoli is favored over cauliflower, which is more popular in America where Long Island and California have been centers of cauliflower culture. Asparagus, or sprouting, broccoli differs from regular broccoli in not producing a solid head.

Cauliflower seed is grown in Europe and must be handled with care. For early crop, plants are started under glass, and after frost danger has passed set out where they will have no further disturbance and where moisture, temperature, and other conditions are favorable.

Best soil is a rich loam that does not dry easily. Therefore, sand is not ordinarily desirable. Rotted stable manure is excellent fertilizer or a commercial fertilizer of 4% nitrogen, 8% phosphoric acid, and 6% potash should be used at about 1 ton per acre depending on original fertility.

Plants should be in position for reaching maturity 4 months before killing frost. Cheesecloth covers protect plants from a cabbage maggot fly that may be very destructive. Considered more delicate and easy to digest than cabbage.



Brussels Sprouts



Turnip



Kohlrabi

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Brussels Sprouts

Brassica oleracea gemmifera

Height to 3 ft., stems being erect and unbranched. Leaves short and about as broad as long, often lobed near base. Buds, or small edible "heads," to about 1 in. in diameter and borne in axils of leaves at lower end of stem. Stem, stout. Leaves best developed at crown.

As scientific name implies, this is merely a variety of species to which cabbage belongs. Relationship is obvious. Not cultivated in America to extent they are in some other parts of world. Popularity here is localized but apparently increasing. Long Island has long been an important center.

Seeds sown in late spring or early summer and transplanted to permanent bed when about 6 in. tall, 18-24 in. apart, in rows 2½-3 ft. apart. When small heads begin to crowd lower leaves, they are cut off and this continues on up stem as plant develops. A good yield from a plant is about 1 qt.

In mild regions, plants may be left in open all winter but where weather is too severe plants are lifted with earth clinging to roots and set in moist sand in a cool cellar, there to continue some production. Brussels sprouts are more delicate than cabbage but are cool-area plants nevertheless.

For serving, Brussels sprouts are cleaned of larger outer leaves, washed, placed in boiling salted water, cooked quickly in uncovered dish, and served hot with butter or other dressing. Market not so strong as for more generally liked and more easily produced relatives, such as cabbage and turnips.

Turnip

Brassica rapa

Leaves clustered around base, with clasping bases, or along flower stalk. Those near base commonly, narrow in general outline and softly prickly. Root, a taproot, usually white-fleshed and not produced into slender crown at top but rather conspicuously flattened from above and often colored above ground. Biennial.

Grows wild in Russia and Siberia and may have originated there. Known to have been introduced into America in 1609 in Virginia. Essentially a cool-season crop, being raised in North in summer and in South in winter or as an early-season crop in North occasionally.

Flowers small, under ½ in. long, yellow; those with open flowers usually closely crowded and topping those not yet open. Fruits about 1½-2½ in. long, with a long slender beak at free end, like little spheres; germinate quickly as is case with many relatives of this plant.

Seeds sown where plant is to mature; if planted early in season, plant may be grown as an annual. Do not do well in hot weather. Seeds planted ½ in. deep in rows 12-24 in. apart at rate of 2 lb. to acre; plants thinned to stand from 2-6 in. apart in rows. Removed plants are used as greens. Young turnips are bunched and sold or mature roots stored.

Experimentally, turnips sown in drills yielded 30 tons compared with 14 tons yielded when seeds were broadcast. Make an excellent food for persons without good storage facilities, because they grow easily, store well, have a good food value and require relatively little care. In North, popular varieties are Purple Top Globe, White Milan and White Flat Dutch; in South, Seven Top.

Kohlrabi

Brassica caulorapa

Conspicuous because of swollen tuber that appears above ground as a sphere 4 in. or more in diameter, with a typical cabbage root beneath and long-petioled leaves growing from and above tuber. Leaves to 10 in. long, of which ½ is petiole and remainder blade, rounded, with a few lobes at base.

Popular garden plant grown in America for stock consumption but in Europe largely for consumption by human beings. Species differs primarily from *B. oleracea* in tuberous stem and small-bladed leaves. Some persons consider it as var. *gongylodes* of *B. oleracea*.

Plants started in open or in hotbeds. Rows should be 12-30 in. apart, with plants 6-8 in. apart in a row. Usual practice is to start plants at 2-week intervals so as to have a steady group of plants reaching maturity through season. Cultivation is essential in early stages.

Naturally a cool-weather plant requiring rich, well-drained loam. Early quick-maturing varieties are recommended for table use and later forms for feeding to stock. Where growth is slow, tuberous portion is likely to be too tough for most persons to enjoy it.

Preparation for table use calls for peeling the tuber, dicing it into ½-in. cubes, then cooking it and serving it much as cauliflower is prepared. For marketing, plants are sold in bunches of 3-5, with leaves usually left on.



Hedge Mustard



Rocket



Gillyflower,
Stock

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Papaverales. Family Cruciferae

Hedge Mustard

Sisymbrium altissimum

Height to 6 ft. Branches spreading, with tips curved upward and stiffest toward base. Fuzzy, with simple hairs, pale green. Leaves alternate, deeply cut but with end lobe by far largest and with some of lateral segments sometimes reduced to slender strips.

Common as a weed throughout northern United States and southern Canada but most troublesome in Northwest and on Pacific Coast. Introduced originally from Europe and now grows in almost any good grain soil, in waste places, or along roadsides. Most evident in late summer and winter.

Flowers pale yellow, about $\frac{1}{4}$ in. across, borne on stems of about same length. Fruits develop into slender, diverging, cylindrical pods about as thick as stems that bear them and break into 2 sections, each with many seeds that are usually flattened on 1 side, brown, to $\frac{1}{2}$ in. long.

Good cultivation will keep this weed in control. If tops are left to mature, whole plant breaks loose and tumbles as a tumbling weed. Fruit tips act as springs to help keep plant going and break to free new seeds which are broadcast in process. Frequently found piled in fence rows.

Seeds of some hedge mustards are used as flavoring but apparently not seeds of this species. Hand pulling, disking, and harrowing a few times will usually keep weed under control but it should not be allowed to mature fruits.

Rocket, Dame's Violet

Hesperis matronalis

Height to 3 ft. Erect, sparingly branched in upper parts. Lower leaves to 8 in. long, tapering at base into a petiole, slightly fuzzy on both sides, in general lance-shaped with shallow teeth along margin. Upper leaves smaller than lower and less likely to be petioled. Biennial or perennial.

An escape from gardens found widely distributed along roadsides and in waste places from Nova Scotia to Pennsylvania, west to Iowa and Ontario; native of Europe and Asia. Seems hardy and well able to maintain itself with a minimum of care. Often found in garden spots of abandoned homes.

Flowers to 1 in. across, purple, pink, or white and fragrant with blades of petals widely spreading to make a most attractive and showy flower. Pods to 4 in. long, spreading or ascending, constricted about seeds so that their location is obvious in a ripe fruit. Flowers from May through August.

This is common old-fashioned garden plant. Does best in relatively moist deep soil, either in shade where it becomes a slender plant or in sun where it may be more substantial. Can grow successfully with other plants crowding it rather closely. Pollination apparently by insects.

Popularity is attested by its many common names such as dame's violet, dame's gillyflower, night-scented gillyflower, rogue's gillyflower, winter gillyflower, sweet rocket, rocket, summer lilac, and damask violet. Scientific name refers to fragrance of flowers in evening.

Stock, Gillyflower

Mathiola incana

Height to 2 ft. More or less woody particularly at base, densely felted. Leaves to 4 in. long, with narrow petiole-like base, blunt at free end, entire. Upper leaves smaller. Whole plant except flowers seems to be grayish and woolly. Biennial or perennial.

Native of area from Greece to southwestern Asia. Standard plant for old-fashioned gardens and has long been popular. Related evening stock *M. bicornis* is more open in its general shape and has pods terminating in 2 long horns, which do not appear on this plant.

Flowers in terminal open clusters, single or double, canary yellow, white, rose, salmon, orange, blood red, purple, light blue, or pink, about 1 in. long, fragrant, variable. Fruits to 2 in. long, thick, stout, and ending in a 2-lobed tip. Considerable variation in time for maturity in different varieties.

Ten-weeks, or independent, stock is annual that blooms in about 10 weeks from time seeds are sown. Normally sown in February or March, transplanted to 1 ft. apart. Various types include some that bloom through summer and autumn because of flowering side branches and some that produce a single large flower group.

Name gillyflower frequently applied to this common garden flower probably is a distortion of Julyflower. Ten-weeks stock of course refers to seed-to-seed period required in annual variety. Fragrance makes plant popular even with those who might not be impressed by its beauty.



Water Cress



Horse Radish



Winter Cress

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Papaverales. Family Cruciferae

Water Cress

Nasturtium officinale

Grows in more or less tangled masses of stems and leaves in shallow water, usually over mud. Stems weak, easily broken. Leaves of 3-9 segments, of which terminal is largest; attractive green, semisucculent, rather crisp. Roots appear at nodes of stem.

Commonly found in springs and spring-fed streams, sometimes at very edge of rather rapidly flowing water. Naturalized from Europe but thoroughly and widely established in America from Nova Scotia to Virginia west to California and Manitoba. Also found in Asia, South America, and West Indies.

Flowers borne at stem tips in rather open clusters, on short stems, to $\frac{1}{8}$ in. broad, white, with petals twice as long as sepals. Fruits to over 1 in. long, spreading or curving upward on stems that may be equal to their length and with seeds arranged in 2 rows. Rather stout tip to fruit.

While plant is usually found in clear spring water, that water may be badly contaminated, so unless sure of the source, cress should be disinfected with some wash such as chlorazene.

This is one of best plants along trout streams for production of such trout-food organisms as fresh-water shrimps, water sow bugs, and the like. It deserves popularity as a salad plant. It should not be confused with the garden nasturtium (*Tropaeolum*) or with water hemlock, which may grow in same place and slightly resembles it but is seriously poisonous.

Horse-radish

Armoracia rusticana

Height to 3 ft. Husky branched plants. Basal leaves on thick petioles, to 1 ft. long, with blade as long again, rough, with crinkled edges or variously modified along margins. Upper leaves narrow, without petioles, with or without toothed margins. Root a solid coarse deep taproot, usually thick with horizontal branches.

Common in ditches, damp spots, and wet waste places particularly in north-eastern United States and Canada, where it probably escaped from gardens after being introduced from Europe. Also cultivated like field crop where conditions are suitable. Does not favor heavy clay or light sandy soils. Potash fertilizers are best.

Flowers borne in loose clusters at ends of stems and from leaf axils, white, showy, to $\frac{1}{2}$ in. broad, appearing in summer. Fruits oblong to globular pods, with short beaks, borne on ends of upward-turning stems. Can be most easily propagated by planting surplus root systems of harvested plants.

Roots planted in furrow, 2-2 $\frac{1}{2}$ ft. apart, horizontally or vertically, preferably where fertilizer has been placed deep. May be grown with cabbage as two plants have enemies that can be controlled similarly. Digging should be done in spring or fall as summer roots are bitter. Ideal roots are deep, straight, and uniform.

Roots should be ground soon after digging as stored roots deteriorate rapidly. To grated root is usually added vinegar and sugar or even mustard to make a standard condiment, considered essential by Europeans, particularly the British, in eating roast beef, broiled fish, or oysters.

Winter Cress

Barbarea vulgaris

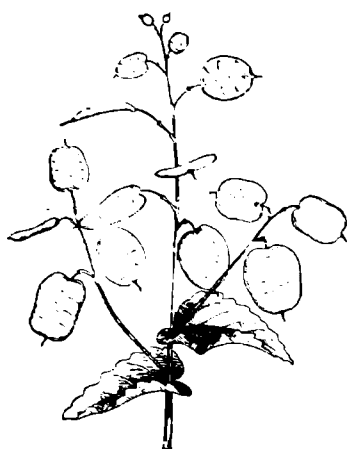
Height to 2 ft. Erect and somewhat branched upward. Lower leaves to 5 in. long, apparently of 1 large terminal lobe and 1-4 pairs of usually opposite lateral ones, most of which are narrowest at base. Lower leaves well-petioled; upper without petioles or with petioles greatly reduced.

Common weed in gardens, fields, and waste places. Naturalized from Europe. Well-established from Labrador to Virginia and in many places west to Pacific Coast though these stations are not necessarily united with each other.

Flowers bright yellow, to $\frac{1}{4}$ in. across, with youngest at top of developing flower cluster, borne on relatively stout individual stems. Fruits spreading or upward-reaching pods, somewhat 4-angled, to about 1 in. long, roughly 6 times as long as supporting stems.

Grows splendidly through warm periods in winter and so appears as bright green rosette in gardens in early spring. Can be eaten on St. Barbara's day in early December when young stems and leaves are tender and about as bitter as best of dandelion greens. Bitterness is a bit too strong for most persons.

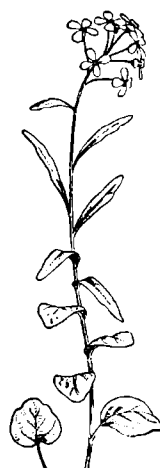
As a potherb, this plant should be cooked in 2-3 waters, fresh water helping to eliminate bitterness. Best to put plants directly into boiling water after they have been thoroughly washed. Salt may well be added and greens should be eaten soon after they have been prepared.



Honesty



Pepperwort,
Toothwort



Spring Cress

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Papaverales. Family Cruciferae

Honesty, Moonwort

Lunularia annua

Height to 4 ft. Rather stout, somewhat branched. Leaves: earliest, opposite; later may be alternate; heart-shaped or triangular in general outline, and with well-developed petioles, margins distinctly toothed, veins rather conspicuous. Root system annual and not extensive.

Introduced from Europe but sometimes established as an escape where it is not too seriously disturbed. Sometimes found growing in cultivated crops from southern Ontario through Connecticut, eastern Pennsylvania, and New York. Most commonly seen as a garden flower particularly in old-fashioned gardens.

Flowers purple, to 1 in. or more across, showy, in loose, relatively few-flowered terminal or axillary clusters. Fruits to 2 in. long and 1 in. wide but very thin, flat, and rounded at both ends to make a wafer-like oval or circular structure. Fruits turn to a straw color and are showy. Seeds relatively few.

Related satinflower resembles this one but fruits are pointed at ends. Plant is perennial rather than biennial or annual. In practice, honesty is sown in late summer and rosettes form before winter comes. From these come flowers next year. Flowering time May and June.

Grown as an ornamental garden flower. Dead tops collected and used in making dry bouquets. Sometimes dried tops are sprayed with colored paints. Known as "matrimony plant" and "pennyflower."

Pepperwort, Toothwort

Dentaria laciniata

Height to 15 in. Erect, smooth or otherwise. Basal leaves develop after flowering and are much like 2-3 stem leaves that appear opposite or whorled and below flowers. Leaves to 5 in. across, usually deeply cut to 5 parts, with sections themselves deeply cut and in this species narrow. Tubers deep, white.

Common in rich, moist, deep-soiled woodlands from Quebec to Florida, west to Louisiana, Kansas, and Minnesota. At least 6 species closely related to this one are found in approximately same range. In this species, tubers are rather spindle-shaped while in some others they are more continuous and less easily broken.

Flowers white or pinkish, to 1¾ in. broad, with backward-curving petals. Petals to ¾ in. long. Sepals about half as long as petals. Flowers rather attractive. Pollination probably by honeybees, other small bees, and syrphus flies that feed on nectar produced. Fruit slender, to 1½ in. long, curving upward.

Tubers make a mildly flavored horse-radish substitute which by many is favored over horse-radish. Amount produced by plant is very small, good for an occasional nibble while on a woodland hike. If end of tuber system away from growing stem is eaten, plant need not be injured.

Some favor mixing root with vinegar but others like to slice it thin and serve it as part of a sandwich or mixed with some relatively tasteless wild plant food. Certainly it needs to be toned down to be appreciated to the full.

Spring Cress

Cardamine bulbosa

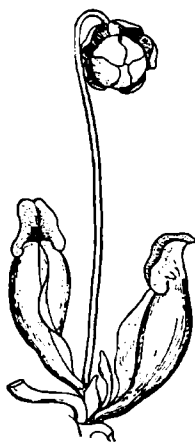
Height to 2 ft. but usually much less. Branched or unbranched. Basal leaves oval or round on ends of long petioles, blade being to 1½ in. long. Upper leaves with or without petioles and to 2 in. long. Rootstock bears tubers. Perennial.

Common in wet meadows or at woodland margins from Nova Scotia to Florida, west to Texas, Minnesota, and Ontario, ascending in Virginia to 200-ft. elevation. Frequently found near springs or where water is oozing from rocks in gorges and similar places.

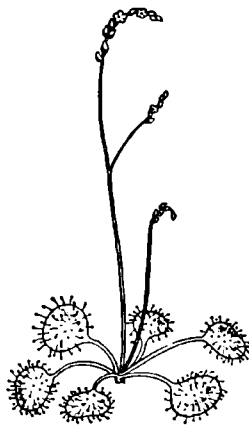
Flowers white, to over 1 in. broad, with petals 3-4 times as long as sepals, white, and rather crowded along upper end of stem, with buds and blooms at very tip and fruits below. Fruits slender, to 1 in. long and narrowest at tip to conspicuously slender end. Seeds oval.

Rather inconspicuous wild flower that blooms from April to June, bears fruits later in season. Not sufficiently attractive to be sought by wild-flower pickers or sufficiently aggressive to establish itself as a pernicious weed. Therefore, it is likely to survive where others might be destroyed.

Tops make reasonably good salad and rootstocks may be eaten at any time of year. Rootstock tastes like a mild horse-radish and may be used as such. Flavor is present also in young green stems and leaves. Older plant parts may be too strong to be palatable.



Pitcher Plant



Sundew



Mossy Stonecrop

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Sarraceniales

Family Sarraceniaceae

Pitcher Plant

Sarracenia purpurea

Height to 2 ft. Leaves spring from base and curve upward to height of 1 ft., are inflated and commonly well-filled with liquid, may be purple- or green-veined, narrowed at base and broadly winged, with open upper end covered on one side with hairs pointing toward opening.

Found in peat bogs and similar acid situations from Labrador to Florida and west to Kentucky, Iowa, and the Canadian Rockies, with related *S. flava* extending range from Virginia to Florida and west to Louisiana. About 8 species in North America.

Flowers large and borne at end of scape that reaches a height of 2 ft., nodding, deep purple or yellow, nearly spherical, to 2 in. or more across, with narrow-middled 5 petals curving over yellow pistil tip. Fruit, 3-celled. Seeds, numerous.

Fact that leaves are commonly well filled with liquid in which many drowned insects may be found has led to idea that plants digest these animals and thus live on them. This is now being seriously questioned, and fact that at least one kind of mosquito spends its larval stage successfully in the liquid supports opposition.

Always of interest to nature lovers. If given reasonable protection, it can recover from depredation. Physiological problem set by its leaves, an interesting gall frequently found on flower, and other characteristics make plant well worth knowing better.

Family Droseraceae

Round-leaved Sundew

Drosera rotundifolia

Height to 10 in. Leaves held relatively close to ground, expanded in terminal portion to round blade that bears on upper surface numerous sticky-tipped structures whose tips are capable of movement toward center.

Found in peat bogs and similar wet acid places or in wet sand from Newfoundland and Labrador to Florida, west to Alabama, California, and Alaska, though California stations are in mountainous areas. In Catskill area in New York plant ascends to 2,500-ft. elevation. Also found in Europe and Asia.

Flowers to $\frac{1}{2}$ in. long, borne along slender erect flowering stem that may be branched once and may bear to 25 flowers, each on a short stem about as long as flowers are wide. Flowers open mostly in bright sunshine. Petals white to red, longer than sepals. Fruit a many-seeded capsule.

Another so-called "carnivorous" plant whose meat-eating properties are questioned by some plant physiologists though they are blatantly proclaimed and pictured in popular-science literature. Leaves supposedly capture insects and digest their bodies thus getting needed nitrogen.

Popular plant for field botanists, some of whom collect it for herbarium use or for experimentation. Plant has such common names as lustwort, red rot, yowwort, rosa solis, eyebright, and dew plant. Leaves richer in vitamin C than any other plant known.

Order Rosales

Family Crassulaceae

Mossy Stonecrop

Sedum acre

Spreading, branching mat, up to 3 in. high and of indefinite length because of rooting at joints. Leaves alternate, to $\frac{1}{4}$ in. long, overlapping, sometimes in 6 rows, light yellowish-green, somewhat succulent, thick, oval, without petioles. Root system, a branching underground arrangement.

Escaped from cultivation on rocky exposures along roadsides from Nova Scotia to Virginia, west through Ontario. Native of northern Asia and established in Europe. Obtainable from most rock-garden supply houses and easily established in suitable environments. At least 30 genera and 60 species in family.

Flowers about $\frac{1}{8}$ in. broad, in clusters of a few without individual stems. Petals bright yellow, narrow, pointed and to 4 times as long as sepals; central flower of a cluster usually 5-parted and others 4-parted. Fruits spreading, slender-tipped, and to $\frac{1}{8}$ in. long.

Juice of fresh plant may cause dermatitis to some persons but it is not generally considered poisonous. Representative of many interesting rock-garden plants or of plants that are grown indoors in pots for their live-forever qualities.

Group has little economic importance except possibly as holders of soil and moisture in crevices between rock exposures or for sale as rock-garden plants. Yellow flowers of this species and the ease with which it grows make it universally popular.



Live-forever



Early Saxifrage



Strawberry

Geranium

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales

Family Crassulaceae

Live-forever, Garden Orpine *Edem telephium purpureum*

Height to 1½ ft. Stems erect from horizontal underground system, stout, smooth, unbranched. Leaves alternate, broadly oval, thickened, succulent, with or without coarsely toothed margins, to 2 in. long, narrowed at base or sometimes with short petioles; lower definitely larger than upper.

Found among rocks, banks, and particularly in old gardens or in areas adjacent to them where plants have escaped and established themselves; usually where there is some moisture. From Quebec to Maryland west to Michigan and Ontario and in gardens elsewhere. Native of western Asia but naturalized in Europe, whence it was probably introduced.

Flowers in densely crowded clusters that are to 3 in. long, with individual flowers about ½ in. across. Petals twice as long as sepals. Stamens, 10. Fruits, to ½ in. long, tipped with a slender point. Blooms little, spreading itself more by freely branching underground parts.

Not listed as a poisonous plant but it may cause dermatitis in some persons. Children almost universally press and blow up the broken succulent leaves to make "balloons"; were poisonous qualities universal, evidence should be stronger.

An excellent old-fashioned-garden plant that can be grown by anyone anxious to make a new garden quickly, but once established it may be difficult to eliminate.

Family Saxifragaceae

Early Saxifrage *Saxifraga virginensis*

Height to 1 ft. Leaves basal, in rosettes, to 3 in. long or longer, with conspicuous midribs, narrowly margined petioles, and toothed or only slightly irregular margins. Leaves appear in well-developed rosettes in fall ready to produce flowers in early spring.

Found in rocky crevices in gorges, by streams, or even in rocky woodlands. From New Brunswick to Georgia west to Tennessee and Minnesota, up to 3,500-ft. elevation in Virginia. At least a dozen species to be found in northeastern United States, some of which range from Gulf to Arctic and west to Pacific.

Flowers borne at ends of branching stems in more or less flat-topped clusters of a few flowers, white, erect, to ¼ in. broad, with petals to about twice length of sepals, there being 5 of each. There are 10 or sometimes 15 conspicuously yellow stamens. Parts of pistil spread apart at tips.

One of popular spring flowers of gorge banks that is fortunately too small to be considered worth plucking and therefore survives destruction at hands of flower collectors. Pollination from March to May may be effected by early bees or by some early butterflies.

Some relatives of this species such as *S. pennsylvanica* are reputed to have roots of medicinal value but it is doubtful if this is of great importance.

Strawberry Geranium *Saxifraga sarmentosa*

Height to 25 in. Leaves all basal, between round and heart-shaped, with very long petioles, with upper surfaces white-veined; red beneath, with up-standing hairs. Whole plant loosely hairy. Has running habit of ordinary strawberry plants, weak rootstock, fibrous roots. Perennial.

Native of Asia, more particularly of China but widely grown as old-fashioned window plant. May escape and establish its own colonies in milder parts of world but is not hardy to North. Of half-dozen saxifragas cultivated for their flowers, this is probably most popular.

Flowers many, white, arranged along upper parts of erect and branching flower stocks. Petals unequal, 2 being much larger than other and upper 3, longest being to ½ in. long or about 4 times as long as shortest, with acute tips, sometimes red spotted or pale pink. Stamens, 10.

Requires an abundance of sun and does best at temperatures between 60–70°F. with a moderate amount of water and a soil composed of ⅔ ordinary garden soil and ⅓ well-rotted manure. Pollination may be effected by butterflies. Few insect enemies or fungous pests.

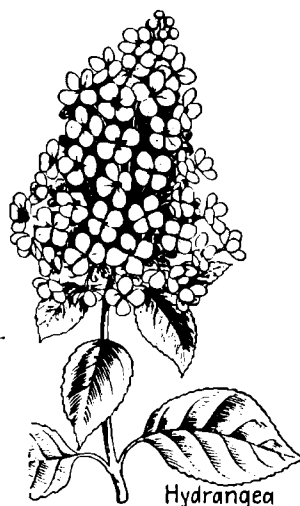
An attractive plant grown not only for its pleasing small lace-like flowers but for beauty of its foliage. Spreading stolons make it easy to propagate without relying on flowering process to produce seeds.



Foam Flower



Miterwort



Hydrangea

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Saxifragaceae

Foamflower, False Miterwort *Tiarella cordifolia*

Height to 1 ft. Leaves irregularly heart-shaped, with coarsely rounded toothed margins, long-petioled, 5-7-lobed, with blade to 4 in. long, inclined to be smoother than those of closely similar bishop's cap leaves, or with hairs on underside more definitely confined to ribs. Leaves rise from rootstock.

Common in rich woodlands where there is good moisture, ranging from Nova Scotia to Georgia, west to Indiana, Minnesota, and Ontario. In Virginia, found up to elevation of 5,600 ft. 6 species in North America, of which 5 are in the West. Others range on to Japan and Himalayas.

Flowers borne at upper parts of erect stem; appear like little white bursts of bloom, the 5 white petals being exceeded in length by 10 conspicuous stamens whose anthers are yellow, with long white central pistil. Fruit divided at tip into 2 parts like a tiara.

One of popular early spring flowers too attractive for its own good. Appears rather later than such flowers as bloodroot and hepatica and is at its best about time leaves of shade trees come into full shade-producing condition. Pollination probably by visits of bees, butterflies, and syrphus flies.

Lends itself readily to transplanting in wild gardens and is commonly found there. Listed in some wild-plant catalogues but doubtful whether plants are grown from seed or collected from wilds. Such a fine woodland flower that it is worthy of every protection. Known as coolwort, false miterwort, gem-fruit.

Bishop's-cap, Miterwort *Mitella diphylla*

Height to 18 in. Leaves mostly basal except for 2 on flowering stem. Basal leaves long-petioled, irregularly heart-shaped or 3-5 lobed, with blades to 2 in. long and with hairs scattered irregularly over both surfaces. Upper leaves in general similar but with shorter petioles and opposite.

Common in rich, moist woodlands from Quebec to North Carolina and west to Missouri, Minnesota, and Quebec and found up to 2,600-ft. elevation in Virginia. 4 species in North America and Asia, of which this is by far most common in eastern North America, some others being decidedly limited in range.

Flowers borne along upper portion of erect flowering stalk that has 2 characteristic small leaves. Flowers white with lacy petals shaped somewhat like a bishop's miter, with 10 stamens not so conspicuous as in foamflower. Fruits flattish, broad, and opening in upper parts.

Fortunately, this flower is so small that its beauty is not appreciated except by those willing to give it close examination. Were it large it would undoubtedly be so popular that it would be quickly eliminated from much of its range. Appears in midspring usually a little before foamflower and before tree leaves have developed fully.

This fine little plant is reputed to have some medicinal value. Common name currant-leaf is as appropriate as its common name bishop's-cap or scientific name *diphylla*. Equally appropriate is the common name fairy cup or fringe cup. Also called false sanicle.

Hydrangea *Hydrangea paniculata*

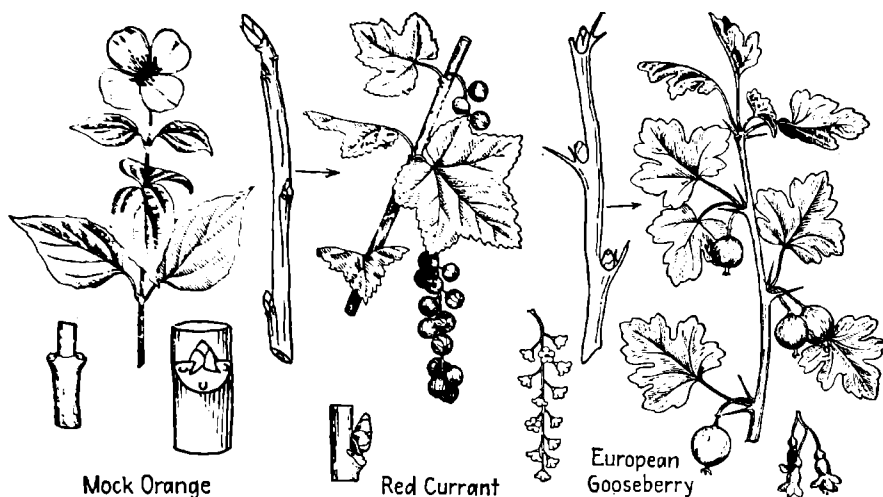
Shrub or small tree reaching height of to 30 ft., forming dense round head. Leaves opposite, to 5 in. long, with toothed margins and drawn-out tips, somewhat fuzzy especially on veins on underside, with petioles but no stipules. May be rooted at joints.

Native of Japan and China but grown widely in suitable places particularly where there is enough moisture in a rich soil and where there is enough sun. *H. paniculata* var. *grandiflora* is one of hardest of hydrangeas and therefore one of more popular in northern part of range. *H. opuloides* is not hardy in North.

Flowers in terminal, compact panicles often with marginal flowers sterile and exceptionally showy. Fertile flowers in center have 4-5 petals and sepals, usually 10 stamens, and a pistil that develops into a fruit that splits freeing many small seeds. Flowering time August and September. Flower buds form in autumn.

Tree form may be developed by cutting back all but strongest shoot of many that may start from a vigorous plant growing in rich soil where there is enough sun and moisture. Some of best blooms are produced by a vigorous pruning of most of plant in fall or early spring, but such plants may need support for huge flower clusters.

One of truly showy plants of front yards in suitable climate. Related greenhouse or southern species have a ready sale as house plants available from florists. Best cuttings are made in February from plants forced for Easter, rooted in sand at 70°F. in March, potted in May, horbedded in August, and bunched in December.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Saxifragaceae

Mock Orange, Syringa
Philadelphus coronarius

Shrub. Height to 10 ft. Branching but with long wand-like shoots that make a graceful hedge plant. Leaves opposite, to 4 in. long, on short petioles, smooth above and slightly fuzzy beneath, with rather distant shallow teeth along margin, 3-nerved, rounded or narrowed at base, more pointed at free end.

Common ornamental shrub, native of central and southern Europe but widely planted in America. Escaped from cultivation in many places in eastern United States. Grows well on steep slopes or in good garden soil. Some 30 species found in North America, Asia, and Europe of which some reach a height of 20 ft.

Flowers numerous, at ends of branches, in clusters, to 1½ in. across, creamy white, very fragrant, with 4 petals 3-4 times as long as sepals whose pointed lobes are longer than calyx cup is deep. Stamens very numerous and possibly half as long as petals. Fruit a dry capsule, flat-topped, splitting lengthwise.

Pruning should be done after flowering since flowers appear on wood of previous year. Propagation by layerings, by cuttings if desirable hybrid qualities should be maintained, or by seeds if hybrids are desired.

One of the favorite ornamentals for suburban and rural homes. Somehow we associate the flowers with graduation time since they are so commonly used for floral decoration then. The related *P. lewisii* is the State flower of Idaho.

Common Currant
Ribes sativum

Shrub. Height to 6 ft., but usually lower when well-managed. Young growth rather densely fuzzy. Leaves 3-5-lobed, to 3 in. across blade, well-petioled, with margins distinctly toothed and veins conspicuous, usually heart-shaped at base. Twigs without spines at joints.

Native of western Europe. Established rather widely as cultivated plants or as escapes. Some 150 species in genus, these being found mostly in cooler and temperate parts of world. *R. nigrum*, black currant; *R. sativum*, red currant; *R. rubrum*, red currant; and *R. alpinum*, mountain currant grown for fruit. Other species, like *R. odoratum*, grown for flowers.

Flowers commonly in clusters of more than 4 and sometimes 10 or more, drooping, greenish-yellow, with a purple ring inside the stamens and outside the style. Fruit, berries that are usually red but sometimes white or even striped, succulent, tart, but definitely edible. Ornamental golden currant has beautiful yellow flowers.

Best near water in moist atmosphere. Can endure shade. Host to blister-rust fungus of white pine; therefore unpopular in some places. Propagated by cuttings taken in fall, put in sand for winter, set out in spring. Fruits borne on stem spurs 2-5 years old, black currant on 1-year-old wood. Stems that have borne should be pruned.

Fruits of currants were collected from wild species by Indians, stored and eaten later. Yield of cultivated plants may be to 400 bushels to acre. Fruits keep surprisingly well. Eaten fresh with sugar or more commonly made into currant jelly or jam.

English Gooseberry
Ribes grossularia

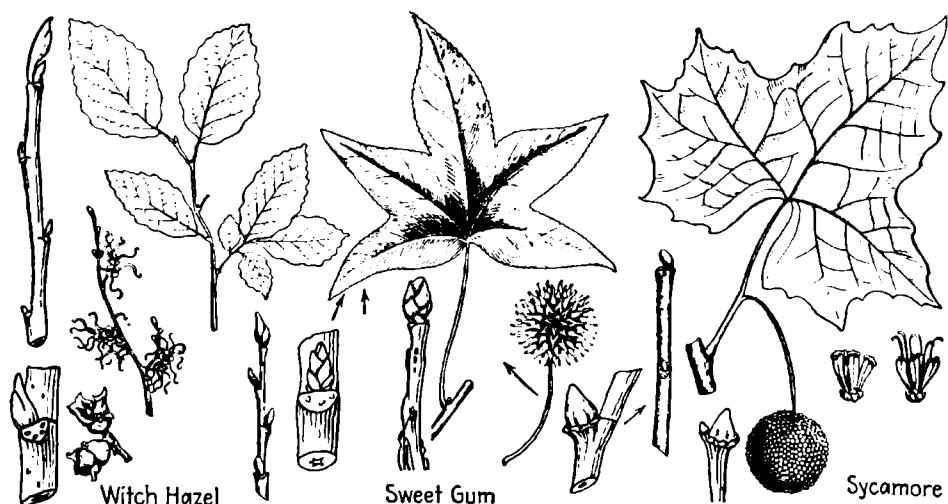
Shrub. Height to about 3 ft. Stocky, bushy plant whose stems are erect, ascending, or reclining. Usually with 3 stout spines at joints though sometimes even better armed. Leaves stiff, with nearly round blades that are to 2½ in. broad, with 3-5 blunt lobes and margins somewhat toothed, with in-turned edges.

Native of Europe, north Africa, and southwestern Asia. Common species cultivated for fruit are *R. hirtellum* with its smooth fruit and *R. grossularia* with its somewhat fuzzy fruit. *R. hesperium* with green-red flowers and *R. speciosum* with red flowers are cultivated for ornament.

Flowers in loose clusters of 1-2, rather than in groups of many as in currants. Flowers of this species greenish, 5-parted, with fuzzy calyx tube about as long as calyx lobes. Fruit not smooth and shining as in currants or as in *R. hirtellum*, nor prickly as in *R. hesperium* or *R. speciosum*.

Propagation largely by layering. Plant is cut back in fall, producing vigorous July shoots that are covered at base by several inches of soil and rooted by fall. They are then separated from parent plant and grown in nursery 1-2 years before being set in field. Host of dangerous white-pine blister-rust fungus.

Fruit produced on 1-year-old wood and 1-year-old spurs on older wood. Branches commonly pruned after fruiting 3 years. Usually about 3 shoots of an age for a 3-year cycle are kept for a plant. Fruits can remain ripe on bushes after ripening and are eaten raw or made into pies, jams, or jellies.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales

Family Hamamelidaceae

Witch Hazel

Hamamelis virginiana

Shrub or small tree. Height to 25 ft. Twigs slightly roughened, yellowish to brown, not stiff, with alternate buds and a peculiar bud at end larger than others. Leaves short-petioled, to 5 in. long, with irregularly shallow-toothed margins, unequally heart-shaped at base and conspicuously veined.

Native of America, ranging from Nova Scotia to Florida and west to Texas, Minnesota, and Ontario. Tolerant to shade of other woody plants. 3 species in genus, of which this is only 1 in America, other 2 being Japanese.

Flowers in bright yellow, flag-like clusters, to $\frac{3}{4}$ in. long, borne in axils of leaves, appearing late in season when leaves are falling. Flowers pollinated in fall yield seeds following fall by expelling them violently from compact, somewhat nut-like fruits that are to $\frac{1}{2}$ in. long.

Leaves commonly affected by aphid gall that makes tent-like structure; fruits, by gall that makes bur-like structure. Wood heavy, hard, 43 lb. per cu. ft., excellent for making brooms and toothbrushes in campcraft. Believed, wholly erroneously, to be of value as divining rods for locating water underground.

Leaves and twigs source of witch hazel that is commonly used in allaying pain. Element of medicinal nature is extracted in alcohol; its fragrance is familiar to most persons. Plants wilt slowly and were therefore recommended for use by the Army as a green camouflage.

Sweet Gum, Bilsted

Liquidambar styraciflua

Tree. Height to 150 ft. Bark, rough. Twigs and branches with conspicuous corky ridges. Twigs with large, angled pith, smooth or slightly fuzzy. Trunk to 5 ft. in diameter, straight, with relatively slender branches. Leaves to 9 in. wide, alternate, of 3-7 lobes forming a star, smooth and dark above. Sap resinous.

Found in low woodlands from Connecticut to Florida, west to Mexico, Missouri, and Illinois. In lower Mississippi areas regularly flooded each year, is great forest tree. Definitely favors an abundance of water.

Flowers: staminate and pistillate in separate flowers on same plant. Staminate flowers lack corolla and calyx. Pistillate flowers lack corolla, develop into bur-like structure, to $1\frac{1}{2}$ in. in diameter that remains persistent through winter with sections opening to shed $\frac{1}{2}$ in. winged seeds in autumn.

Wood to 37 lb. per cu. ft., hard, not strong but takes an excellent finish and used extensively as veneers for interior woodwork. Gum collected as resinous substance used as substitute for storax gum of commerce. 128,000 seeds per lb. with 50-75% germination. Flowers appear in April and May.

In autumn, this is one of most beautiful of trees, as its leaves turn a gorgeous red. 12 species of birds including bobwhite and wild turkey have been known to eat seeds or fruits; it ranks thirteenth in importance as quail food in Southeast. Gray squirrel, chipmunks, and marsh rabbits also known to feed on plant.

Family Platanaceae

Sycamore, Plane Tree

Platanus occidentalis

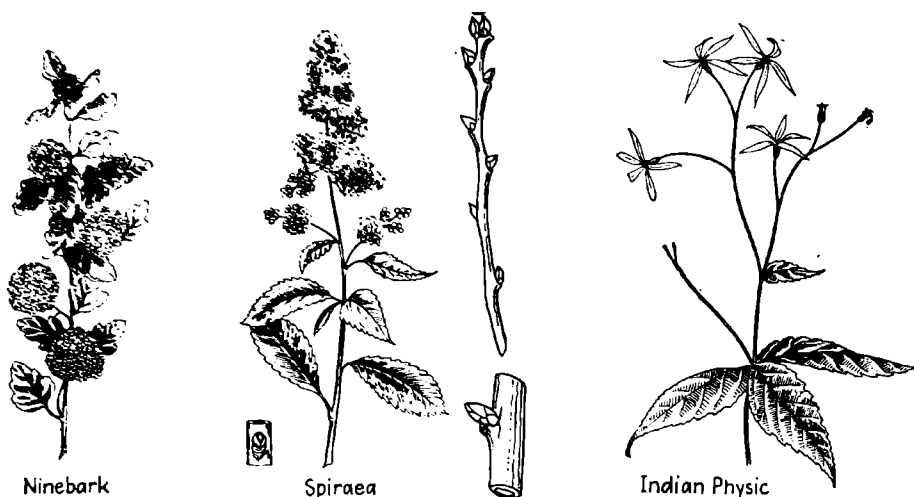
Tree. Height to 170 ft. Trunk to 11 ft. in diameter, rising in a straight column to 80 ft., almost of uniform diameter. Limbs erratic branching, making rather open head to 100 ft. across. Bark conspicuously mottled and scaling off in sheets. Buds alternate, surrounded by leaf scar. Leaves to 9 in. wide, somewhat star shaped.

Found in wet woodlands and along streams from Maine to Florida, west to Texas, Kansas, Minnesota, and Ontario. Family is small, containing only 1 genus and 8 species, all native of North Temperate Zone. European sycamore or a hybrid is planted extensively as a street tree because of its relatively narrow shape. To 2,500 ft. elevation in Appalachians.

Flowers very small, in ball-like clusters; staminate, with few stamens; pistillate with about same number of pistils. No calyx or corolla apparent. Fruit a ball-like structure to 1 in. in diameter hanging through winter at end of long swinging stem and rupturing to free wind-scattered nutlets. May live 600 years.

Wood weighs 35 lb. per cu. ft., reddish-brown, hard, difficult to split, weak. Probably largest tree in eastern North America though not tallest. Germination poor except in moist, open, mineral soil. Seeds harvested in fall should be frozen in dry place, planted in spring to $\frac{1}{4}$ in. deep.

Wood used for butcher's blocks because of its hard splitting qualities. Also used in making tobacco boxes and to some small extent as veneer because of beauty of medullary rays in radial section. Much of it made into furniture but it has a tendency to warp sometimes. In eastern Texas, a good shade tree.



Ninebark

Spiraea

Indian Physic

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Rosaceae

Ninebark

Erythronium alpinum

Shrub. Height to 10 ft. Branches recurve gracefully. Bark peels off in long sheets, often with many layers showing. Twigs and leaves smooth. Leaves alternate, petioled, bluntly lobed or sharply so, commonly with heart-shaped base, with medium-toothed margin. Blade to over 2 in. long.

Common on river banks and in gorges in the wild from Quebec to Georgia and west to Tennessee and Michigan. Rare commonly found growing as an ornamental in some landscaped walk order or against a wall or building foundation. A dozen North American species and one native of Manchuria.

Flowers in terminal, somewhat flattened or globular clusters to over 1 in. across, with each flower from 1-1/2 in. across, whitish or sometimes pinkish, with many stamens and 1-5 pistils developing in each flower. Fruit 2-valved, yielding few seeds per fruit. Units of fruit are to nearly 1/2 in. long. Flowers June and July.

Grows in moist but well-drained site in sun or shade. Fruits available as food for some kinds of wildlife in September and October but are inferior to most others at that time. About 600,000 seeds per lb. but propagation largely by layering and separation of young plants.

Used primarily as an ornamental and as a hedge or barrier. Recommended by some soil-erosion technicians as a soil anchor for use on hillsides. Provides good cover for wild birds. Although known to have been eaten by at least 3 species, it nevertheless is not an important food source for wild birds.

Meadowsweet

Spiraea latifolia

Shrub. Height to 6 ft. Erect, branched or not, with purplish-red nearly smooth stems. Leaves alternate, smooth or nearly so, coarsely saw-toothed, to around 2 in. long and 1 1/2 in. wide but much larger on young vigorous shoots or plants, paler on the underside.

Found in rocky, moist woodlands or open fields for the most part east of the Alleghenies from Newfoundland to Virginia but also west in the northern part to Saskatchewan. Sometimes planted as an ornamental. About 75 species of the genus native of the Northern Hemisphere, of which 4 are described briefly below.

Flowers in dense terminal, somewhat wand-shaped clusters. Individual flowers white or pink, to 1/2 in. broad. *S. prunifolia* has flowers borne on old wood in leafless, flat-topped clusters; *S. salicifolia* has pink flowers; *S. alba* has white flowers and a fuzzy flower cluster; *S. tomentosa* has leaves tawny beneath and whole plant more or less fuzzy.

Among the most popular of ornamental shrubs offering variety of color, flowering time, and shape of branches and leaves. *S. vanhouttei* with many white flowers in small clusters on drooping branches may be most common, followed by more delicate *S. thunbergii* with slender smooth leaves. *S. brumalda* bears pink blossoms in July and August.

The common names of some of the above include in order as named bridal wreath, willow-leaved spiraea, meadowsweet, hardhack or steeplebush, Van Houtt's spiraea, Thunberg's spiraea, and Brumald's spiraea. The meadowsweet here emphasized may occur as a troublesome weed in New England.

Indian Physic

Gillenia trifoliata

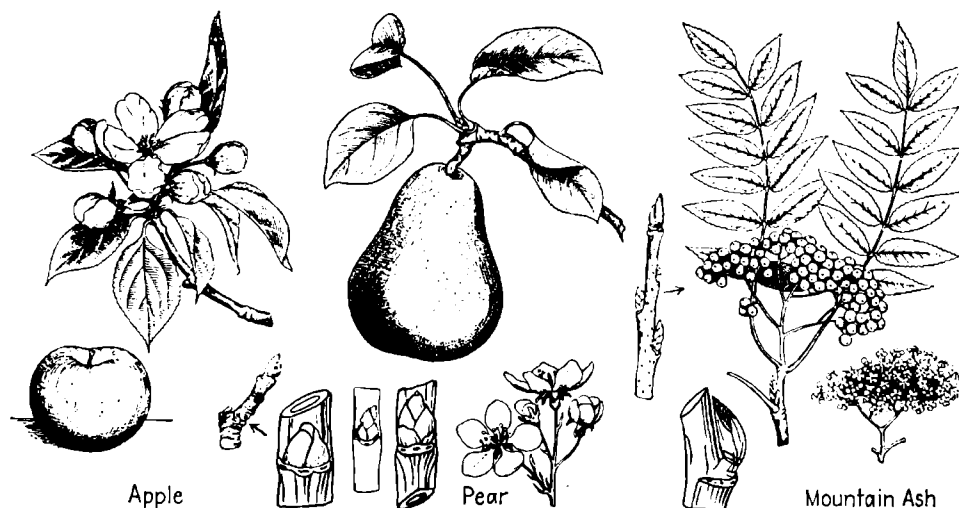
Herb. Height to 4 ft. Erect, branching, smooth, with slender reddish stems. Leaves alternate, compounded of 3 leaflets that are to 3 in. long, pointed at ends, with sharply toothed margins and small stipules at base. Leaves sometimes merely lobed instead of compound, particularly the upper. Root system perennial.

Native of woodlands from Ontario to Georgia, west to Missouri and Michigan ascending in North Carolina to 4,500-ft. elevation. Is successfully cultivated but not widely adopted. 2 species in eastern North America suitable for use as ornamentals.

Flowers in few-flowered open clusters on slender stems. Petals, 5, narrow, spreading, white or pinkish, to 1/2 in. long. Calyx cylindrical, persistent, 5-lobed, reddish, and narrowed at the throat. Stamens, many. Fruit somewhat fuzzy, pod-like structure slightly longer than calyx, 5 pistils to a flower. Flowering time May through July.

Plants are hardy and easy to cultivate in ordinary garden soil. Usually propagation is by using the seeds or by dividing the root system. Of the 2 species, in *G. trifoliata* the plant is smooth and the pods are fuzzy; in *G. stipulata* the plant is fuzzy and the pods are smooth.

G. trifoliata is commonly known as bowman's root, false ipecac, Indian hippo, western dropwort, and Indian physic while *G. stipulata* is known also as Indian physic and as American ipecac. *G. stipulata* ranges through central and southern United States.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

Apple
Pyrus malus

Tree. Height to 20 ft. Trunk to 3 ft. in diameter. Bark rough, scaly, and dark. Twigs rather coarse, somewhat flexible, with fruiting spurs crowded with leaf scars. Leaves to 4 in. long, darkest above, coarse-veined, alternate, short-petioled. Roots both shallow and deep.

Native of Europe and Asia but cultivated in temperate regions where seasons are suitable. Can exist in a variety of well-watered, well-drained soils. Special varieties (500) developed for eating in different seasons, for use in pies, cider, evaporation, and so on. Crab apples are grown particularly for use in making jellies.

Flowers borne on fruiting spurs, opening as leaves develop. Sepals, 5. Petals, 5, white or pink, to 3 in. across. Pollination mostly by bees or by flies and necessary for crop development. Fruit too well known to need description, maturing from midsummer to snow depending on variety.

Propagation by slip grafting on seedling stock and by slip and bud grafting on developed trees. Attacked by scale insects, codling moths, a curculio, many aphids, red bugs, tent caterpillars, meadow mice, deer, and many fungi. Spray program must recognize necessity of pollinating insects. Red cedar host for apple-scab fungus.

A major fruit crop of United States. Fruits rich in vitamins B and C. Storage at 29°F. prolongs keeping qualities, and control of carbon dioxide in storage area helps. Orchard may bear in 4 years and yield to 15 bushels per tree by tenth year and to 50 bushels per tree or 500 per acre at maturity. Wood weighs 50 lb. per cu. ft., excellent firewood.

Pear
Pyrus communis

Tree. Height to 60 ft. Pyramidal, long-lived, less open than apple. Trunk to 3 ft. in diameter. Twigs commonly with thorn-like spurs that bear short-pointed leaves to 4 in. long, with finely cut margins, coarse veins, and dark upper surfaces, with petioles sometimes as long as or longer than the blades. Roots relatively deep.

Native of Europe and Asia but established sometimes as an escape from Maine to Pennsylvania in woodlands and cultivated widely throughout the world in temperate regions. Asian pear is a native of China. Most cultivated pears are hybrids of European pear *P. communis* and Asiatic pear *P. serotina*. Hybrids include Keiffer, LeConte, and Garber pears.

Flowers in few- to several-flowered clusters, white, to 2 in. across, borne on ends of short twigs of preceding year. Petals, 5. Sepals, 5. Some varieties self-sterile and do best when pollinated by some other variety. Among these are Bartlett, Kieffer, Sheldon. Best to plant varieties that have overlapping flowering time.

Commercial propagation by seeds, by importing seedlings, and by grafting seedlings as in apple. No more than 4 rows of a variety recommended for one orchard. Fruits usually hand-picked and stored with care. Bartlett pears may be held 3 months at 30°F. Codling moth and fire blight among serious pear pests.

Fruit rich in sugars and eaten by many animals. Vitamin B present in good quantity. Some 30 commercial varieties in America, some producing to 400 bushels per acre. Annual United States crop may be around 15 million bushels. The South is too hot ordinarily for good pear production. Dwarf varieties have been developed that simplify harvest problems.

Mountain Ash
Sorbus aucuparia

Tree. Height to 50 ft. Round-topped, relatively open. Bark gray-brown, relatively close in young trees. Twigs and buds fuzzy but not sticky. Leaves compound, of 9-15 leaflets, each to 2½ in. long, short-pointed or blunt, sharply and finely toothed along the margin and not individually petioled.

Escaped or planted along roads or even in waste places. Native of Europe and Asia but now widely established and frequently escaped and persistent. About 10 species, of which 2 are native of North America, *S. americana* in the East and *S. scopulina* ranging from Labrador to Alaska and south to Pennsylvania and Utah.

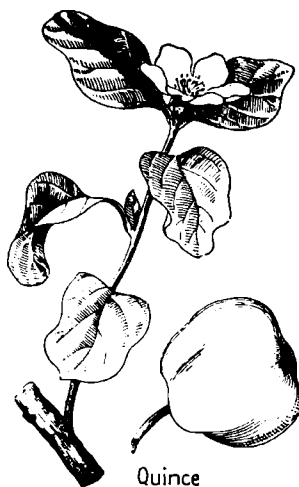
Flowers about ¼ in. across, in flat or round-topped, rather compact clusters that are to 6 in. across. Sepals united into a 5-lobed cup. Petals, 5, spreading, with slender bases. Stamens numerous. Odor unpleasant. Fruit globular, bright red, persistent, usually under ½ in. in diameter. Whole cluster produces an impressive effect.

Wood weighs about 35 lb. per cu. ft., soft, weak, light brown. Seeds stratified in sand 90 days at 32-41°F. May be sown in spring. Seeds weigh 83,000-105,000 per lb. Mountain ashes are susceptible to San Jose scale and to a borer that enters the trunk if base is not kept clear of trash.

Fruits of European species eaten by many birds but less favored than those of American species, eaten by ruffed grouse, blue grouse, sharp-tailed grouse, fisher, marten. Twigs eaten by moose and white-tailed deer. Fruits make good jelly if cleaned with hot water, cooked with 1 cup water per lb. of fruit and 1 cup of sugar to 1 cup of juice before cooking to jelly.



Japanese Quince



Quince



Agrimony

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Rosaceae

Japanese Quince *Cydonia japonica*

Shrub. Height to 6 ft. Profusely branching, with spiny branches. Leaves dark-green above and lighter beneath, alternate, roundish, coarsely toothed, to 3 in. long, forming a rather compact mass of vegetation stimulated to compactness by pruning.

Native of Japan. Widely planted as a hedge or individual ornamental plant. Related *C. sinensis* is not hardy in the North. 4 distinct species, all coming from China or Japan and all having some merit as ornamentals.

Flowers in clusters of 2-6, appearing with or just before leaves, some scarlet and a few forms pink or white. Flowers to 2 in. across; since they appear on many parts of the plant they make an effective showing during flowering period, normally in March and April.

Propagation by seeds that are stratified in sand in the fall and sown in spring, or by grafting on greenhouse stock or on the root system of the common quince, which may be more hardy than the Japanese ornamental varieties. May also be propagated from cuttings using half-ripened wood, or branches may be layered to take root at joints.

One of most popular of spring ornamental woody plants, serving dual purposes as flowers and as a thorny, practically impenetrable hedge. *C. sinensis* cannot be expected to survive north of Philadelphia.

Quince *Cydonia oblonga*

Tree. Height to 20 ft. Bark very dark to almost black. Branches conspicuously crooked, spineless, slender. Leaves to 4 in. long, blunt-tipped, entire-margined, fuzzy on the undersides, alternate, with rather conspicuous stipules at base.

Native of central and eastern Asia and naturalized and established in the Mediterranean region. One closely related species comes from Turkestan. Flowering quince was formerly considered in same genus but is now in *Chaenomeles*.

Flowers borne on growth of year, singly and appearing with foliage, white or pinkish, to 2½ in. across. Calyx lobes are shed. Petals, 5. Stamens, 20. Styles of pistil, 5. Fruit appears without stem at ends of stout twigs, globular or pear-shaped, fuzzy, to 4 in. through, yellow, sour, 5-celled.

Should be grown in heavy, relatively dry soils. Propagation by stratification of seeds planting them in spring, by cuttings of wood that is from 1-4 years old, by layering the branches, by budding, or by grafting. Growth slow. Flowers may appear in fall when plant is in fruit as well as in spring.

Grown primarily for fruits used in preserves and jams. Plant could serve as an ornamental because of its grotesque habit of growth and because of the beauty of foliage, flowers, and fruits.

Agrimony *Agrimonia gryposepala*

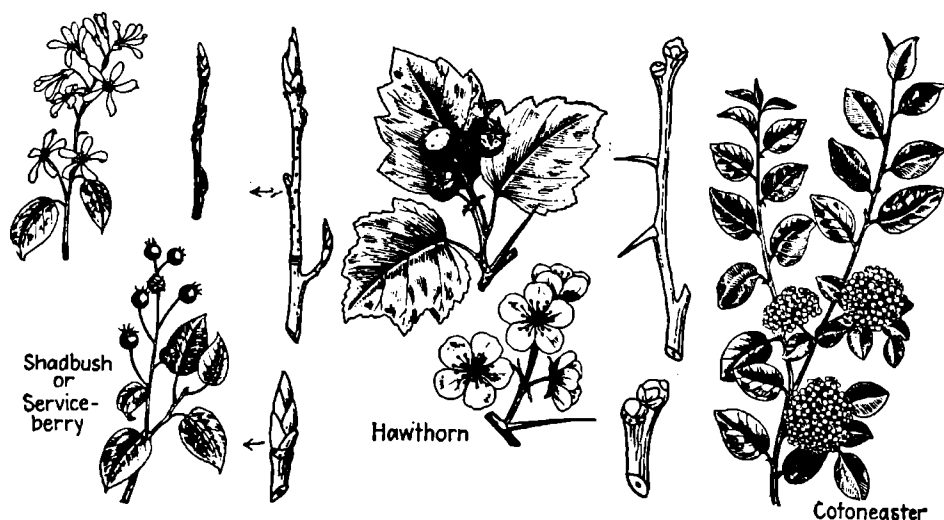
Herb. Height to 4 ft. Leaves compounded of 5-9 leaflets exclusive of small secondary ones. Leaflets more or less elliptic to oblong. Part bearing flowers covered with minute down of a sticky quality with longer, widely spreading hairs interspersed. Relatively slender root system.

Found in woodlands, thickets, and waste places from Nova Scotia to North Carolina and west to California and Minnesota. Some 15 species of the genus native of the Americas and ranging south into the Andes of South America.

Flowers yellow, to ½ in. across, arranged along sides of an erect hairy stem. Petals, 5. Calyx tube, 5-cleft. Stamens, 10-15. Fruit definitely top-shaped with deep, vertical grooves along sides of lower half and a ring of upward-stretching hooked appendages at widest part.

Probably best known because of the sticktight qualities of the fruits, which enable them to attach themselves to clothing, particularly wool socks, and become firmly embedded. Probably plant spreads itself largely by the rides stolen by the barbed fruits.

This is a perennial of dry soil areas and while fields may sometimes become badly infested, the plant yields to ordinary cultivation practices. It can hardly survive a season in which a cultivated crop is maintained.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

Serviceberry, Juneberry
Amelanchier arborea

Shrub or small tree. Height to 60 ft. Trunk to 2 ft. in diameter. Bark faintly and beautifully streaked longitudinally. Twigs slender, with buds somewhat like those of beech but smaller and thicker at base. Leaves to 3 in. long or longer on young shoots, sparingly silky when young but smooth with maturity.

Common in dry woodlands, chiefly on hillsides. Ranges from Nova Scotia to Florida, west to Louisiana, Arkansas, and Quebec. Other closely related species extend the range considerably and may only be separated from this one with difficulty. At least 25 species of which a dozen occur in North America and 1 in Mexico.

Flowers appear just ahead of leaves. Petals white, to 4 times as long as sepals, each to $\frac{3}{4}$ in. long; slender and not stiff. Flowers from March through May. Fruits small, red or purple, spherical, deliciously sweet and nutritious, ripen from June through August.

Wood hard, brown, weighing 49 lb. per cu. ft., used for tool handles and as the "lancewood" of fish poles. Seeds germinate at about 70%; about 10,000 usable plants can be expected from 1 lb. of seeds numbering about 50,000. Seeds normally distributed by birds.

Fruits known to be eaten by 27 species of birds including ruffed grouse, bobwhite, and mourning dove, while the leaves or bark are eaten by white-tailed deer, cottontails, and other game. Plants used in erosion control and as ornamentals. Fruits used by man as are blueberries. Named shadbush because plant bloomed at time shad ran up rivers.

Hawthorn
Crataegus sp.

Usually relatively short, stout trees reaching to a height of possibly 20 ft., with a trunk diameter of less than 1 ft., with slender rather crooked branches, often well-armed with spines of variable size. Leaves alternate, variously shaped, usually double-toothed. Usually have long taproots.

Commonest in pasture lands and along fence rows. Some 1,300 species in the north temperate regions with the eastern United States being particularly rich in species. "Species splitters" among botanists recognize few limits to the numbers that might be eventually described.

Flowers somewhat like small apple blossoms but many have a most disagreeable odor, usually clustered at ends of twigs, white or whitish, $\frac{3}{4}$ -1 in. across and appearing in late spring or early summer. Fruits with relatively large, hard, separable centers, usually red and variously flavored.

Wood of most species, hard, close-grained, reddish-brown, weighing about 45 lb. per cu. ft. and used in turning napkin rings, tool handles, canes, and rulers. 1 lb. of seeds numbers about 6,000-40,000 with 40% germination and may yield 2,500 usable plants.

Provides good food and cover for many kinds of wildlife, making up nearly 10% of food of grouse in northeastern United States. Also eaten by pheasants, quail, deer, cottontails, and cattle. Considered a source of honey. Juiciest fruits may be made into acceptable jelly for human consumption. Trees give soil anchorage.

Pyracanth, Cotoneaster
Cotoneaster pyracantha

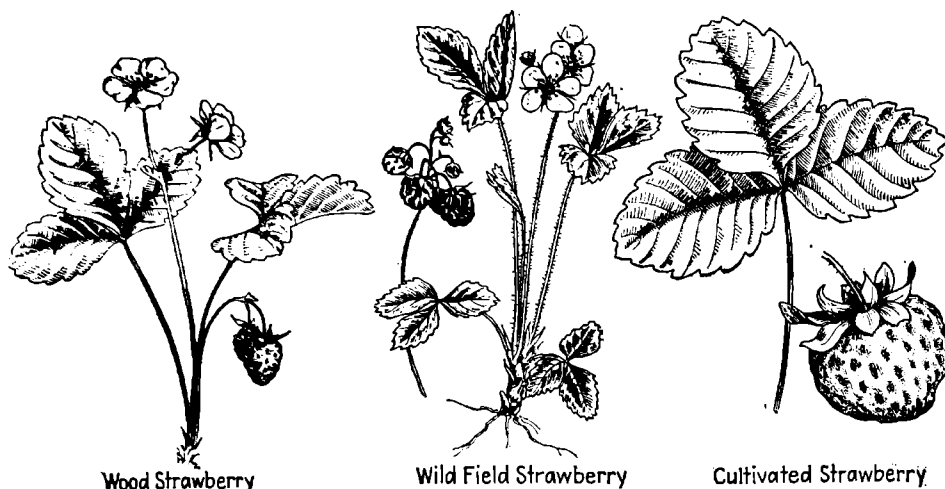
Shrub. Height to 8 ft. Twigs armed with slender spines to 1 in. long. Leaves evergreen, to 2 in. long, narrow at base and short-petioled, blunt-ended, somewhat shining, dark-green on upper surface, smooth on both sides, forming when healthy a dense mass of foliage.

Native of southern Europe and western Asia but grown in America as ornamental and escaped from cultivation and established independently in isolated areas from Massachusetts to Texas. About 40 species in the genus native of the Old World, none in Japan.

Flowers in many-flowered, somewhat flat-topped clusters usually at or near twig tips, about $\frac{1}{4}$ in. across, with 5-lobed calyx, 5 petals, and many stamens. Fruit with 2 bony seeds in each cell instead of the usual 1 found in *Crataegus*. Blooms in May and matures fruit by October.

Does well in any good garden soil. Evergreen species are propagated by half-ripened cuttings kept under glass and started about August, or by layering in fall, or by grafting on mountain ash, quince, or hawthorn. Foliage of some species is brilliant in autumn. Seeds may be sown in fall or stratified for spring planting.

Grown as an ornamental for brilliant or evergreen foliage or for flowers or for black or reddish fruits. Fruit is generally attractive to birds, particularly robins, and the plant provides some wildlife cover where it is established.



Wood Strawberry

Wild Field Strawberry

Cultivated Strawberry

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Rosaceae

Wood Strawberry

Fragaria vesca

Height to under 12 in. Leaves arise from a basal tuft with runners giving rise to other leaf tufts. Leaves long-ovate, of 3 leaflets, thin, sharply toothed, with terminal one the larger and the petioles and underside of leaves well-supplied with hairs.

Naturalized from Europe in eastern and middle Atlantic states but native to the North and found from Connecticut to New York, west to Kentucky and Ohio as native plants. In the closely related variety *americana* the hairs on the petioles are more closely appressed and less abundant.

Flowers white, borne on flowering stalks reaching to sometimes to nearly 1 ft., with a few flowers in an open cluster. Calyx, 5-lobed. Petals, 5, white. Whole flower to nearly 1 in. across. Stamens numerous, with yellow anthers. Fruit red or sometimes white, with "seeds" borne scattered on a smooth or almost even surface.

Pollination by insects. Natural propagation probably as much by runners as by fruits. The determination of species, subspecies, and varieties is a problem for specialists. To most of us, this plant is either long, delicate, small-seeded woodland strawberry or something so close to it that it makes little difference.

The fruits of this strawberry are so delicate that it is almost impossible to collect a "mess" of them. They practically melt in one's mouth. The plants do not bear the abundance of fruits nor are the plants themselves so abundant as the related field strawberry.

Wild Field Strawberry

Fragaria virginiana

Height usually to under 8 in. Leaves arise from tufts on runners, with petioles to 6 in. long and 3 rather large leaflets that are coarser than those of the woodland strawberry. Leaflets rather coarsely toothed, blunt-tipped, and hairy, with lateral ones uneven at the bases.

Commonest of the wild strawberries in its range and found often in abundance in dry soil in fields and pastures from Newfoundland to Florida and west to Oklahoma and South Dakota, there being several races within this range and several closely related species in territory adjacent to it. These races roughly represent Canada, New England, Virginia, Illinois, and so on.

Flowers white, in relatively few-flowered, open clusters at the end of erect flowering stems, to nearly 1 in. across. Sepals, 5, green and in some erect lobes. Petals, 5, white. Stamens, numerous. Fruit an irregularly globular mass of red flesh with the "seeds" embedded in pits over the rather roughened surface.

Izaak Walton says of the strawberry that "doubtless God could have made a better berry but doubtless God never did." It is certain that those who have eaten wild strawberries straight, in shortcake, or in a sherbet doubt if God could have made a more tasty fruit.

Undoubtedly, the fruits provide some food for wild birds and mammals as well as for man and the plants act as soil anchors with their binding runners and leaf tufts scattered here and there.

Cultivated Strawberry

Fragaria chiloensis

Perennial, with leaves growing in clumps from scaly perennial more or less woody runners. Leaves of 3 leaflets each, well-toothed, rather glossy above, bluish-white beneath, and, in this species, overtopping the flower-bearing stalks. In var. *ananassa* the leaves are lighter green on both sides than in the type species.

Garden strawberry is probably a hybrid of many species including particularly *F. chiloensis* of the Pacific Coast region from Alaska to California and from Peru to Patagonia, *F. virginiana* the field strawberry of the East, *F. moschata* the haultbois of Europe, and *F. vesca* the alpine and perpetual strawberry of Europe.

Flowers white or reddish in some forms, in open clusters with or without stamens, with 5-lobed calyx and 5 petals. Whole flower to over 1 in. across. Fruit an enlarged, red pulpy juicy structure with "seeds" embedded in the surface. When imperfect varieties are planted, 1 row of perfect flowers is set to every 4.

Propagation is usually by runners set in rich, well-drained warm soil free from alkali in rows 18 in. apart, in rows 3½ ft. apart (8,300 plants per acre), or in hills 3½ ft. apart (3,630 plants per acre); cultivated to free weeds first summer; mulched with straw in winter; and in season, picked over every 2-3 days.

Yields of 3,000-4,000 qt. per acre are common and 9,000 qt. per acre have been produced. Sold as fresh or frozen fruit or made into sirup, jams, candies, preserves, ice creams, and so on. Important enemies include weather, a nematode, birds, slugs, a weevil, a crown borer, and many fungi.



PHYLUM SPERMATOPHYTES. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

Barren Strawberry
Waldsteinia fragarioides

Tufts of 3-foliate leaves arising from a rather stout creeping rootstock. Leaves long-petioled, with leaflets blunt at the free end, rather narrowly wedge-shaped at the base, with toothed margins, darker green above than below, leaflets being to 2 in. long.

Often growing in rather dense stands in woodlands and on shaded hillsides. Ranges from New Brunswick to Georgia, west to Indiana, Minnesota, and Ontario. Native of America, 5 species being found in the north temperate parts of the world. This species found in Oregon as well as in the general area indicated.

Flowers like yellow strawberry blossoms, 3-8 on a flowering stalk, in loose, open, but erect clusters, each flower being to $\frac{3}{4}$ in. broad. Calyx 5-lobed. Petals, 5. Stamens, many. Fruit not fleshy like a strawberry but made up of 4-6 finely fuzzy "seeds." Flowering period May to June.

The plant is named in honor of the German botanist Franz Adam von Waldstein-Wartenburg, who lived from 1759-1823. This species has leaves that look so much like those of a strawberry to an amateur that its common name is easily understood, but to botanists so many differences are apparent that it is hard to understand such confusion.

The plant has little economic importance. Since the flowers fall to pieces almost as soon as they are picked, they make inferior wild-flower bouquets. The fruits may be eaten by some forms of wildlife but they perform no outstanding service in this connection.

Wild Cinquefoil
Potentilla canadensis

Sprawling herb with runners to over 2 ft. long bearing tufts of leaves and flowering stalks at intervals. Leaves of 5 leaflets, long-petioled, somewhat hairy. Leaflets rather blunt at the apex and acute at the base, to 1 in. long, with saw-toothed margins and rather distinct veins, lighter in color on the underside.

Found on lawns and in dry soil such as pastures from New Brunswick to Georgia, west to Texas and Minnesota, being found up to 6,300-ft. elevation in North Carolina. Over 300 species of *Potentilla*, all native of the northern temperate regions, of which nearly two dozen are found in the northeastern United States.

Flowers yellow, to $\frac{1}{2}$ in. across, with many stamens, 5 broad petals, and 5 acute calyx lobes that are about as long as petals but much narrower. Fruit appears as a bunch of dry "seeds" without fleshy structure found in related strawberry. Some potentillas have large showy flowers while others have inconspicuous ones.

This species does best where competition is low on poor, relatively dry soil. It does not stand competition and may be taken as an index of poor fertility. It survives on acid soil and some consider it an indicator of sour soil. Where this plant is found growing in abundance, one should not expect good results of forest trees set out for reforestation.

Control is by enrichment of the soil and encouragement of competition. Plowing and sowing rye in infested land may serve to eliminate it. It probably serves some value as an anchor for soil that might otherwise be exposed to the elements and be eroded away.

White Avens
Geum canadensis

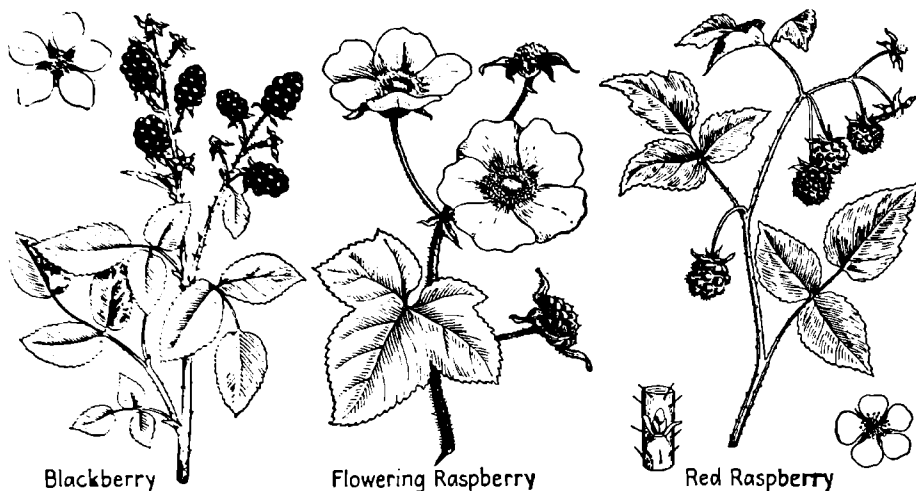
Herb. Height to 2½ ft. Branched in the upper parts, softly hairy throughout. Leaves of 3-5 segments, with the terminal lobe of the basal leaves being much larger than any of the lateral segments. Basal leaves well petioled, and stem leaves with short petioles or none.

Found in shady waste places. Ranges from Nova Scotia to Georgia, and west to Louisiana, Kansas, South Dakota, and Minnesota. Some 40 species of the genus found in north temperate regions, in southern South America, and 1 in South Africa. At least a half-dozen in eastern North America.

Flowers white, with 5 reflexed calyx lobes and 5 relatively inconspicuous white petals making a flower about 1 in. across. Many stamens. Bases on which hooked fruits are borne are densely hairy after fruits have been shed. Fruits provided with a long style terminating in a hook and making a sticktight.

Pollinated no doubt by insects. While some of the genus can well be classified as weeds, it is doubtful if this one can. The purple avens *G. rivale* is sometimes called chocolate root because the root may be used as a substitute for cocoa.

A number of the geums are known as weed seed purities but most of them yield readily to cultivation and are not so persistent that they can be considered serious. The fruits of most of them are characteristic hooked stickights found in clothing or in the fur of some animals.



Blackberry

Flowering Raspberry

Red Raspberry

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Rosaceae

Blackberry

Rubus allegheniensis

Shrub. Height to 8 ft. Old canes are purplish and bear numerous straight stout prickles. Leaves compound, of 3-5 leaflets with terminal one the largest, rather soft and velvety beneath, with serrate margins shallowly toothed. Root system extensive, survives separation readily.

Relatively common in dry soil from Nova Scotia to North Carolina and west to the Allegheny Mountains, with other closely related species extending the range and with cultivation practices spreading the plants through most of United States. Valuable varieties include Agawam, Kittatinny, Snyder, Early Harvest, and Taylor.

Flowers borne on rather long-stemmed clusters with supporting stems covered with sticky hairs. Flowers white, to 1/2 in. across, with petals broader toward tip. Fruit, shiny black, juicy lobes with hard centers grown together and not appearing like a cap when plucked.

Old canes set 3-4 ft. apart, in rows to 1 ft. apart. Young shoots 2 ft. long are clipped back to few inches to induce branching. When developed, lateral branches are pruned to 8-20 in., the upper being kept the shorter. Canes that have borne fruit are cut back to ground and next crop borne on new canes that have developed.

A most important commercial crop particularly where superior hybrids have been developed. The fruits keep well and can be shipped considerable distances in safety. They make excellent juices for flavoring, superior pies, jams, and jellies and are at their best taken fresh from the shrubs when dead ripe.

Flowering Raspberry

Rubus odoratus

Shrub. Height to 5 ft. Erect, branching canes free from prickles, with bark that peels off in long strips, with younger twigs somewhat bristly. Leaves long-petioled, not compound, with 3-5-lobed blade, to nearly 1 ft. broad, with heart-shaped base and finely cut margins.

Found at the edges of woodlands particularly in areas where soil is shallow. Ranges from Nova Scotia to Georgia, west to Tennessee, Michigan, and Ontario, with a number of races represented within the range. The closely related salmonberry *R. parviflorus* has smaller white flowers.

Flowers showy, to 2 in. across, in rather open clusters at the ends of branches, purple or sometimes white, with yellow anthers on the many stamens and rather long though slender calyx lobes. Fruits like flattened hemispheres composed of a number of flesh-covered, stone-like "seeds"; have a poor flavor.

Persons differ in judgment of the edible qualities of the fruits, some contending that they are good while others disagree vigorously. The large fruits can be used to piece out more delicious species if the substitution is not too generously observed.

63 species of birds known to eat *Rubus* fruits, the fruit ranking eighteenth in importance as quail food in the Southeast. It is also eaten by bear, squirrels, deer, porcupines, rabbits, elk, moose, hares, beaver, skunks, chipmunks, and other animals.

Red Raspberry

Rubus idaeus strigosus

Shrub. Erect, to 6 ft. high, well-armed with hooked prickles on the stems. A well-managed plant has about 9 vigorous canes on it. Stems root where they contact the soil. Leaves alternate, compound, of 3-5 leaflets of which the terminal is the largest, with petioles well-covered with whitish hairs.

R. idaeus, European raspberry, commonly grown on Pacific Coast. *R. strigosus*, American red raspberry, like the above has an erect cane, native of United States and Canada. *R. occidentalis*, blackcap raspberry, is smaller fruited than *strigosus*, with curved canes. *R. neglectus*, purple cane red raspberry, is a cross between *strigosus* and *neglectus* in character.

Flowers to 1/2 in. across or more, white, erect, with somewhat fuzzy sepals. Fruit red, and when picked comes free of receptacle as a hollow cap. Varieties of the European include the Antwerp and Amsterdam; of the American, the Marlboro, June, and Surprise; of the blackcap, the Ohio, Plum, and Palmer.

American red raspberry propagated by transplanting suckers; the black and purple by tip layering. Cool summers are best. Set plants 2 ft. apart in rows 6 ft. apart. Train to 2 wires. Remove old wood after the fruiting, keeping about 5-7 new canes to develop each year. Do not pinch back red raspberry in summer ordinarily.

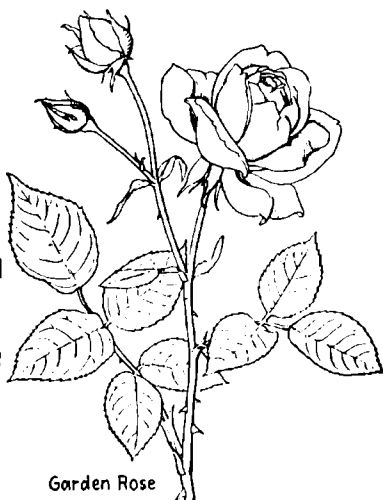
Well-managed purple raspberries may yield more than any other with black next and red last. Good crops may be borne for to 15 years though 8-10 is the average for red and 6-8 the average for black or purple. In normal times, some 50,000 acres in United States are given to cultivation of raspberries.



Moss Rose



Wild Rose



Garden Rose

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Rosaceae

Moss Rose *Rosa gallica*

Shrub. Height to 4 ft. Canes and other woody parts with crowded, stiff prickles of unequal length intermixed with weak bristles giving a "mossy" effect. Leaves alternate, thick, compound, of 3-5 leaflets, to 6 in. long, the leaflets being to 2 in. long, dull above and fuzzy beneath.

Native of Europe and western Asia. An old popular garden rose that persists around abandoned homes or escapes and becomes well-established. Closely related to the cabbage rose *R. centifolia*, native of the Caucasus and one of the most ancient of cultivated roses.

Flowers single or double, usually erect (nodding in cabbage rose), solitary or in open groups of 2-3, pink to deep red, to 3 in. across; with petals spreading and sepals leaf-like with ragged edges. Fruit nearly spherical or somewhat elongated, to ½ in. through, dull red and without the sepals.

Chosen here as an old-fashioned garden rose, useful either for its flowers or for its foliage. It flowers through summer and into autumn, and with its large flowers and dense dark foliage provides excellent landscaping service. It is easily propagated by division or by cuttings.

Druggists recognize oil of rose, rose water, and sirup of rose as products of roses, largely of their aromatic petals. Some of these are used in candies, some in medicines to improve taste, some to improve fragrance. Dried rose petals are frequently sprinkled in linen to add fragrance.

Meadow Rose *Rosa blanda*

Shrub. Height to 4 ft. Canes erect and armed with only a few prickles or with none. Leaves compounded of 5-7 leaflets, the leaflets being to 1½ in. long, rather sharply saw-toothed along the margins, short-stalked, and pale beneath. Stipules rather broad.

Found commonly in rocky places from Newfoundland to New Jersey and west to Missouri and Ontario, with related species extending range through most of the United States and southern Canada. *R. pratincola* is the common wild rose of the Middle West and has densely prickled stems.

Flower showy, to 3 in. broad, solitary or in few-flowered clusters, pink, single, with many yellow stamens in the center. Fruit nearly globular and almost ½ in. through, almost smooth, and with the mature fruits showing the sepals erect rather than spread as they may be at first.

The related *R. pratincola* may spread considerably by means of underground structures that may be over 1 ft. underground and radiate 5 ft. or more from the central system. *R. blanda* is a rather early wild rose blooming in June and July while others may bloom through to the autumn months.

Provide beauty, game cover, and game food and may become a weed that yields readily to cultivation. Indians ate the fruits raw. Jellies are now made from them, usually after frost has come. High in vitamin C. Known food of grouse, quail, prairie chicken, deer, opossum, coyote, bear, pheasant, mountain sheep, and wild turkey.

Tea or Garden Rose *Rosa odorata*

Shrub. Height variable to 3 ft. or more. Stems smooth, with prickles that are relatively few, scattered, hooked, and stout. Leaves compounded, of 5-7 leaflets, partially evergreen, with the leaflets to 3 in. long, dark shining green above and lighter and smooth beneath, with saw-toothed margins. Root system substantial.

R. odorata is native of western China but is cultivated in many forms and has been hybridized freely so that the garden rose most of us know is really a combination of many kinds of roses or many variations. Most popular tea roses of gardens and florists are probably of this species.

Flowers borne on the shoots of the year, 1-3, white, pink, salmon, or yellow, to 3 in. across, exceptionally fragrant. The variety *gigantea* has flowers that are to 6 in. across. In typical China rose, sepals are entire (not shown in illustration) and fruits are almost globular and red.

Roses may be produced by seeds but the most common practice is to layer the canes, make cuttings, or graft desired cuttings on hardy stock. For the amateur the layering process is the simplest and safest. A mature cane may be bent to the ground and a portion of it buried in earth. When it has become rooted, it may be separated.

Roses are important commercially, making the backbone of the florist business. Sentimentalists have ascribed a vocabulary to different kinds that is meaningless to most men but may mean much to women. One of the most popular hybrids is the red Jacqueminot "Jack" made by crossing *R. borboniana*, Bourbon rose, and *R. gallica*.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

Choke Cherry
Prunus virginiana

Shrub or small tree. Height usually over 10 ft. Bark gray, close, with disagreeable odor and a bitter taste. Leaves thinner than in black cherry, and with marginal teeth spreading rather than incurving, less rounded and more slender, sometimes with secondary teeth showing on the major teeth.

Along river banks and wet hillsides or long abandoned fence rows. Ranges from Newfoundland to Georgia, west to Texas and Manitoba. A close relative, the Rocky Mountain wild cherry, continues the range on to the Pacific Coast, differing in that the fruit is sweet and the leaves thick, more like those of black cherry.

Flowers white, to nearly $\frac{1}{2}$ in. across, borne along a drooping central axis that terminates leafy shoots. Petals about the length of the stamens. Sepals persistent rather than dropping off as they do in the black cherry. Fruit stringent, deep red or yellow, with a tone that is not corrugated like that of black cherry.

Wood of little economic importance since the plant never reaches a large size. Leaves, like those of the black cherry, may cause serious poisoning to cattle if eaten after they have wilted. The poisoning is rapid and affects the animal's brain as well as the heart and lungs.

Plant used as a soil anchor in erosion control because of habit of developing long roots that sprout at intervals to form new tops. From 3,000-5,000 seeds per lb. which may be collected from July through September. Fruits of plants known to be eaten by bear, rabbits, quail, pheasants, and grouse. Fruits make good jams.

Black Cherry
Prunus serotina

Tree. Height to 100 ft. Trunk diameter to 5 ft. Twigs with bitter aromatic bark. Bark of trunk dark, peeling off in squarish flakes irregularly. Leaves alternate, to 6 in. long, stiff and firm when developed, shining above, light green beneath where also most smooth.

In open places and woodlands. Closely related to the choke cherry, the teeth of whose leaves are much less coarse. Ranges from Nova Scotia to Florida and West to Texas, Kansas, and South Dakota with closely related species extending the range considerably. More likely to favor dry spots than is choke cherry.

Flowers borne on short stems along a central axis, the whole cluster erect at first but eventually drooping and being found at the end of leafy branches, relatively small, about $\frac{1}{2}$ in. across, white, with clusters to 6 in. long. Calyx persists with the stamens. Fruit nearly globular, black, $\frac{1}{2}$ in. through, thin-skinned.

Wood hard, beautiful reddish-brown, strong, capable of taking a beautiful polish, weighing 36 lb. per cu. ft. Wilted leaves may seriously poison cattle, with those from vigorous young shoots being the most dangerous and those cut in spring and summer worse than those cut later in the season.

Wood very valuable in cabinetmaking, being one of the best of native woods. Fresh ripe fruit of food value to man and may be eaten raw, cooked, or made into preserves or jellies. Domestic stock poisoned by wilted leaves may have staggers, convulsions, difficult breathing, and may die within an hour.

Pin or Wild Red Cherry
Prunus pennsylvanica

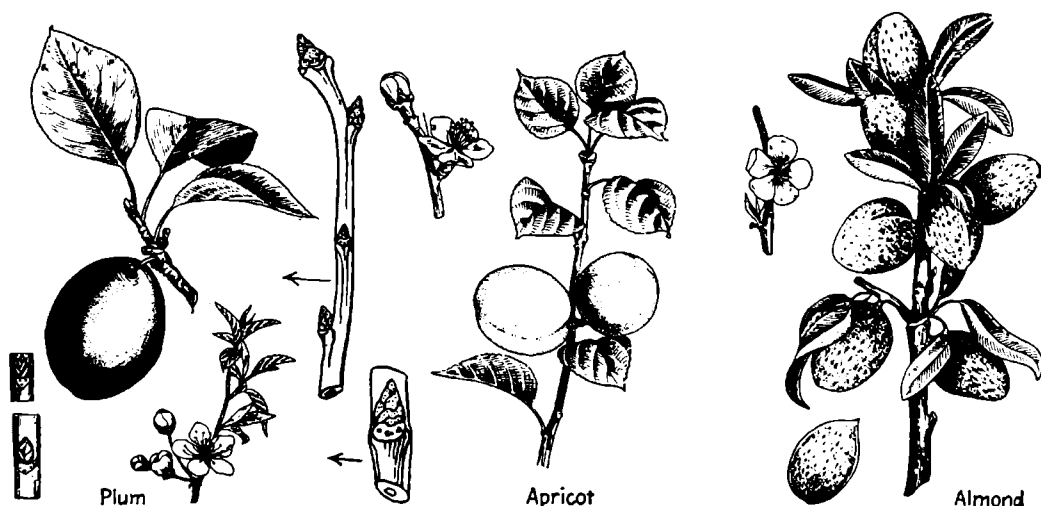
Tree. Height to 40 ft. Relatively open, branched. Trunk to 20 in. in diameter. Bark of young twigs smooth, thin, red-brown; of old trunks, to $\frac{1}{2}$ in. thick, breaking into horizontal bands, bitter. Leaves to 4 in. long and to $1\frac{1}{4}$ in. wide, with margins bearing fine incurving tipped teeth, often with glands at the tip.

Common in rich soils, in mixed forests, appearing abundantly on burned-over areas; does well even on sand. Ranges from Newfoundland to the shores of Hudson Bay to the eastern slopes of the coastal range of the mountains in British Columbia, south through Iowa, Tennessee, and North Carolina and somewhat farther south in the Appalachians.

Flowers bear both stamens and pistils, appear when the leaves are half-grown, on slender inch-long stems in groups of 4-5, arising from a common point. Fruit ripens from July through September as a $\frac{1}{2}$ in., pale red-skinned, large-stoned, thin-fleshed, sour cherry that seems to be a favored food of many species of birds; 23 species known to feed on it.

Wood light, soft, light brown, 31 lb. per cu. ft., close-grained, uniform. Seeds 8,000 per lb. and available for harvest from August through October. Tree short-lived but an excellent hedge-row plant though it may be host to some apple pests. Is known to be emergency food for beaver where poplar is lacking.

Leaves that have been wilted are reported as being poisonous to livestock. Used frequently as grafting stock for commercial sour cherry where poor soils are present. Fruit a bit too sour for human consumption when fresh but may be made into excellent jelly or cooked with other fruits. Moose, bear, deer, rabbits, prairie chicken, quail, grouse, and pheasants known to feed on it.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

1. Domestic Plum
Prunus domestica

2. Japanese Plum
Prunus saliciana

3. American Prune Plum
Prunus americana

Large open trees, with young twigs of (1) mostly fuzzy, of (2) mostly smooth, of (3) either smooth or fuzzy. Leaves alternate; of (2), with finely cut margins of (3), with coarsely cut edges; of (1), to 4 in. long, coarsely and irregularly cut along the edges, thinly hairy above and fuzzy beneath.

A cultivated tree. (1) native of Europe and grown most extensively in the Western states; (2) native of Asia and introduced more widely than (1); (3) native of America with its greatest popularity centering in the Central and Southern states. All may occur as escapes near areas where they have been cultivated.

Flowers few in a cluster, white or creamy, to 1 in. across, fragrant, growing from short spurs, with the supporting stems hairy or minutely fuzzy. Fruit highly variable in different varieties but usually not depressed about the stone, firm, commonly bluish-purple and relatively tough-skinned.

Pollination by bees, syrphus flies, and other insects or by self if insects fail to visit. Commercial propagation commonly by budding on a variety of stocks depending on soil and other requirements. Hardiness is procured by grafting desired varieties on American stock. Pests include a curculio and a brown rot.

Over 30 varieties recognized. Properly cared for, a plum tree in the East may yield 1-4 bushels, and more in the West. The common prune is (1); dried, it makes an important article of commerce. For home use, fruits are hand-picked. Fruits are rich in sugar and may be canned or preserved.

Common Apricot
Prunus armeniaca

Relatively small, round-topped tree. Bark distinctly reddish and much like that of a peach. Twigs smooth. Leaves to 3½ in. long, alternate, abruptly short-pointed; margins with blunt-tipped teeth, smooth above and fuzzy on the veins beneath, with glands on the petioles.

Native of China or of Japan. 3 species recognized: *P. armeniaca*, the common apricot of Europe; *P. mune*, the Japanese apricot; and *P. dasycarpa*, the purple or black apricot. Crossed with the plum, it produces the plumcot. Russian apricot is a small race of the common apricot.

Flowers pinkish-white, usually borne singly or in small groups much in advance of the leaves, to 1 in. across and with a short stem or none at all. Fruit highly variable, rounded or flattened, smooth or, when young, with a felty covering, yellow with a reddish overcast. Flesh firm and free from ridged stone.

Not so hardy as a peach and cannot survive heavy, soaked soil. Does best where there is a late spring in the East. Propagation is by seed or more largely by grafting desired tops on rooted seedlings, preferably on peach or plum stock rather than on apricot. It bears every other year.

Fruit used largely as a dessert, either fresh, dried, or preserved in sirup. Brandy is also made from the apricot. Because of the beauty of the bloom, some apricots are grown as ornamentals and trained against walls, preferably against those that do not face south.

Almond
Prunus communis

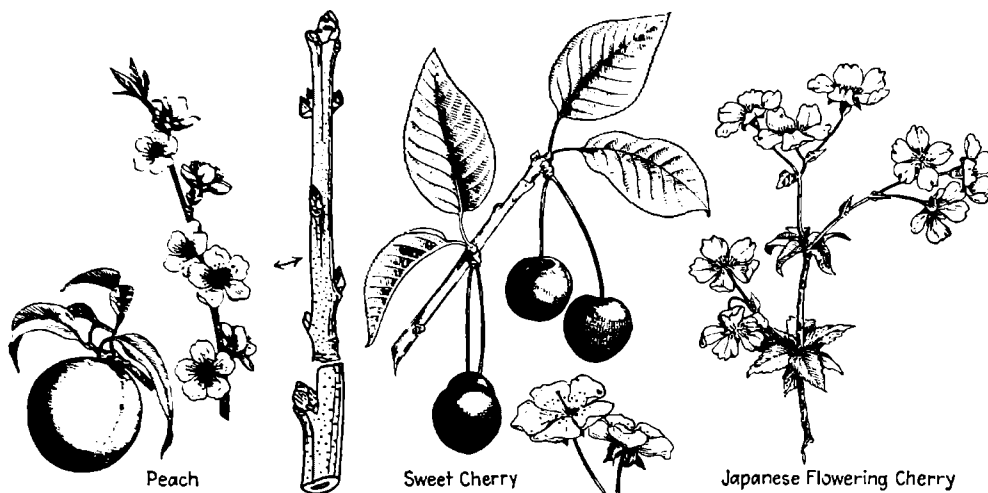
Tree. Height to 25 ft. With light-colored, smooth branchlets, and with old bark bitter, gray, and close. Leaves alternate, shining, firm, with margins finely uneven, to 4 in. long, taper-pointed, and the petiole usually with glands on the upper side.

Probably originally from Asia or the Mediterranean region but now cultivated widely and in suitable territory established as an escape. In America, most frequently cultivated on the Pacific Coast where it has been grown for more than half a century. More tolerant of drought than most fruit trees but will survive standing water over root.

One of the earliest flowering of the fruit trees, in California blossoming in February. Bitter almonds are white-flowered; sweet almonds, pink-flowered. Propagation mostly by budding and grafting, trees being kept compact in warm regions and open in cool. Over 25 varieties grown in California.

Wood hard and compact but not of value compared with the nut. In dry weather, the hulls normally open, freeing the nuts. Sulfur used in removing strains. Bitter almonds are raised for the extraction of prussic acid. Sweet almonds include thin- and hard-shelled varieties; in the latter ¾ weight may be edible meat.

Before World War II, United States imported 11,441,000 lb. of almonds mostly from Italy, with Spain and France following. Used largely as food. Sweet almonds yield 44-55% oil; bitter, 35-45% oil. Oil is used in cosmetics and with drugs. Rod of Aaron supposed to be from almond tree so Jews carry almond rods in certain festivals.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Rosaceae

Peach

Prunus persica

Tree small, low, weak, relatively short-lived, with colored, smooth, close bark and rather rubbery smooth twigs. Leaves to 9 in. long, smooth, shining above and lighter in color beneath, alternate, taper-tipped, commonly with glands on the petioles, and with tendency to fold toward the upper surface and to be twisted.

Native of China. Grown in United States and Canada where the temperature does not go below -15°F . *P. persica* has been modified by other stock and we have the peen-to or flat peach; the long, oval South China peach; the late, firm, yellow Spanish peach; the semicling or clingstone North China peaches; and the Persian peach.

Flowers beautiful, solitary, pinkish, to 2 in. across, appearing before leaves. In some, petals are smaller, even down to $\frac{3}{4}$ in. long. Fruit has hard central stone surrounded by a delicious flesh and thin furry skin, with stone deeply pitted, hard and clinging to or free from flesh.

Propagation commonly by grafting onto suitable seedling stock. Pollination by insects or sometimes by self. Fruits vary in flavor, lasting quality, and size and for shipment are generally picked before ripe but are best for canning when tree-ripened. Nectarine is a peach variety with smooth plum-like skin.

Tree may yield to 4 bushels of fruit and 1 acre may produce to 250 bushels a year, but financial return varies greatly because of market conditions, storm, weather injury, and insect or fungous pests. Tree may begin bearing the third year and continue until 12 years old, the yields being greater every other year.

1. Sour Cherry

Prunus cerasus

2. Sweet Cherry

Prunus avium

Tree. (1), small, with close gray bark, producing suckers freely from root. (2), large, 1-trunked tree not producing suckers. Leaves (1), stiff, short-pointed, without developed glands on petiole, to 4 in. long; (2), limp, long-pointed, with 1, 2, or more petiole glands, to 6 in. long.

Both are cultivated and natives of Eurasia and may exist as escapes. (1) includes cherries known as pie cherries of such varieties as Amarelle and Morello while (2) has been developed to produce at least 3 types, the sour Duke *regalis*, the soft-fleshed Heart *juliana* and the firm-fleshed Bigarreau *duracina*.

Flowers white, about 1 in. across, appearing in (1) slightly in advance of and, in (2), with the appearance of leaves. Fruit of (1), globular, sour, soft-fleshed, and globular-stoned, red; of (2), globular or heart-shaped, yellow or red, sweet or sometimes bitter and more firm-fleshed, with variations suggested above.

Growing of sweet cherries and sour cherries for profit on a 1-crop basis is a gamble because while sour cherries are grown easily, their market is poor; and while the market for sweet cherries is good their culture is rather difficult. Profits have been attained at around \$300 an acre where markets were close at hand.

Fruits are sold fresh, canned, made into fruit juices for flavoring drinks, or are used in making brandy. Cultivated cherries are usually pruned to head 2-3 ft. from the ground to permit easy harvest. Sweet cherries for sale as fresh fruit are picked before fully ripe and the sour when they are ready for use.

Japanese Flowering Cherry

Prunus lannesiana et al.

Tree. Height to 30 ft. With pale gray, close bark. Branches spreading, to make a thick relatively close head. Leaves with rather long, toothed marginal outline, green or somewhat reddish when they begin development.

This species native of Japan and introduced into Europe about 1870. Closely related species include *serrulata* with blunted points on leaf margins and with smooth leaves; the hairy-leaved, single-flowered *yedoensis*; and the double-flowered *sieboldi*. These all come from Japan or China or eastern Asia.

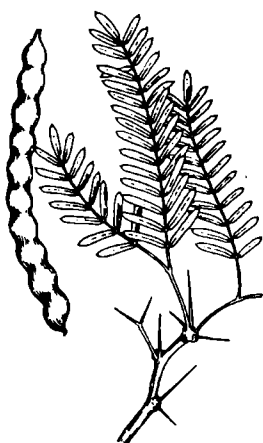
Flowers of all borne on branched, short stems, with the bud from which the flower cluster comes forming an enclosing cup to $\frac{1}{2}$ in. long. Flowers of *lannesiana* are pink and fragrant, while those of *serrulata* are white, of *sieboldi* pink, and of *yedoensis* pink or white. Fruits not important when compared with others.

Flowering cherries vary considerably in their ability to withstand severe winter weather, some being hardy even over the Canadian border. Probably most famous of Japanese flowering cherries are those at Washington, D.C. that bloom at Easter.

These plants are grown primarily as ornamentals. In Japan, the common species in the temple grounds is *P. yedoensis*, its flowering occurring at about the time of certain of the national festivals.



Cat's-claw



Mesquite



Screw-bean

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Cat's-claw
Acacia greggii

Tree. Height to 30 ft. Trunk diameter to 1 ft. With many spreading branches that are angled lengthwise and armed with stout recurving spines at bases of leaves. Bark to $\frac{3}{8}$ in. thick, furrowed and peeling in narrow scales. Leaves to 3 in. long, as shown, with leaflets to $\frac{1}{4}$ in. long, in 4-5 pairs opposite each other.

Found on dry gravelly places and steep hillsides or canyon walls from western Texas to southern California, north to Colorado; more common at the lower altitudes. Some 300 species of *Acacia* with several in the United States but most of them in Africa and Australia, only a few found in temperate zones.

Flowers on slender stems, in heads that are to 1 in. through, yellow, with 2-3 clusters together toward the branch tips, fragrant. Calyx half as long as petals. Fruit, pods that in mid-August are light green, turning to red and showy, to 4 in. long and to $\frac{3}{4}$ in. wide, constricted between the seeds.

Wood heavy, strong, close-grained hard, brown or red; with yellow, thin sapwood. Tree drought-resistant. Seed germination about 60%, 1 lb. of seeds yielding about 200 usable plants. One of the best bee plants, yielding an abundance of useful nectar. Cattle feed on it and the plant withstands heavy grazing. Poor shade plant.

Spines give the names cat's-claw, devil's claw, and rear blanket. Seeds used by Indians for food. A gum similar to gum arabic exudes from the plant. Named after Josiah Gregg, a frontier author and "doctor." Excellent cover for jack rabbits, nesting site for verdin, roost for Gambel's quail. Good soil anchor. Wood used locally in various ways.

Mesquite
Prosopis glandulosa

Tree or shrub. Height to 20 ft. Trunk diameter to 1 ft. Gracefully drooping branches make a round-topped plant. A pair of sharp spines at the axils of the leaves. Leaves to 10 in. long, twice pinnate, with long slender petioles, each with slender leaflets to 2 in. long and to $\frac{1}{6}$ in. wide, smooth, dark-green, sharply pointed.

May be almost buried in sand with only a few feet visible while the roots extend downward for 50 ft. to water. A dry-land plant ranging from Texas to California, into Mexico and north to Kansas with related species extending range. About 15 species, of which 2 occur in our Southwest and the others in tropical or subtropical areas.

Flowers in densely flowered spikes to 5 in. long, appearing from April-June; much visited by bees. Petals to 4 times as long as sepals. Fruit a slender, pointed pod to 8 in. long and $\frac{1}{2}$ in. wide, constricted between the seeds. Pods ripen in September or October and are sweet-meated.

Indians eat fruits, pounding whole pods to powder and extracting woody part. This is mixed with water and baked in a basket under sand in hot sun for several hours to make a sweet cake. Indians wove cloth from the bark. Plant is attacked by a bark-boring beetle and by another that bores into the wood.

Cattle graze on the plant with no ill effects to either. It provides food, cover, or nesting sites for jack rabbits, Gambel's quail, white-winged doves, ground squirrels, porcupines, raccoons, coyotes, deer, skunks, phainopeplas, mockingbirds, road runners, robins, thrashers, and others. It is a common host for desert mistletoe.

Screwbean, Tornilla
Prosopis pubescens

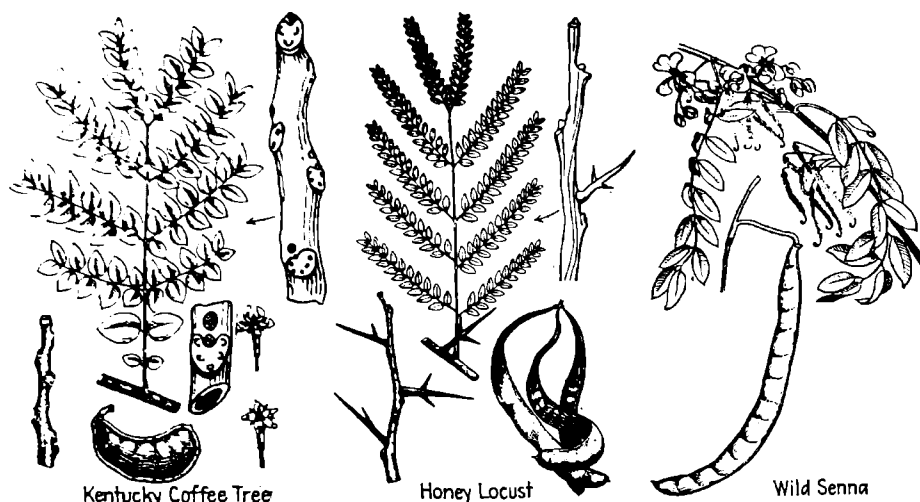
Tree. Height to 30 ft. Trunk diameter to 1 ft. Branches round in cross section, smooth, light red-brown when mature and armed with strong spines to $\frac{1}{2}$ in. long. Distinguished by the gray-barked immature twigs from the darker barked twigs of mesquite. Leaves to 3 in. long, compounded of oblong leaflets to $\frac{3}{8}$ in. long and $\frac{1}{8}$ in. wide.

Found along gravelly and sandy flats or in loam along canals and rivers from the Rio Grande Valley in western Mexico through northern Mexico to southern California and north to Nevada, Utah, and Colorado. Closely related to the mesquite.

Flowers yellow, opening first in early spring; found in clusters in axils of leaves in cylindrical spikes and to 3 in. long. Petals 3-4 times as long as sepals. Fruit ripens through summer and falls off in autumn, characterized by being twisted into a narrow spiral of to 20 turns, to 2 in. long, and with seeds to $\frac{1}{2}$ in. long.

Wood hard and durable in contact with soil. Plant provides a good browse for cattle and for some forms of wild animals. The green or ripe beans are eaten by cattle; Indians eat the pods raw or grind the ripe ones to make a meal from which a cake is baked. Bobwhite, road runners, and Gambel's quail use the thickets of screw bean for cover.

Indians and white men alike use the wood for fuel and for certain kinds of construction. This species reaches its greatest size in the lower Colorado Valley, and in the valley of the Gila River in Arizona.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Kentucky Coffee Tree

Gymnocladus dioica

Tree. Height to 110 ft. Trunk diameter to 3 ft. Usually with a narrow, rounded top but often dividing from 10-15 ft. above ground. Twigs coarse, blunt, to $\frac{1}{2}$ in. through at tip first year, dark-brown to gray. Leaves to 5 ft. long and 2 ft. wide, divided into 5-9 parts, subdivided to 6-14 leaflets.

Found usually on rich bottom lands or planted as an ornamental. Ranges from southern Ontario to Pennsylvania and west to Oklahoma, Nebraska, and South Dakota but not common anywhere. This is the only species in the genus. Genus closely related to that of the honey locust.

Flowers showy, white, at ends of twigs clustered along a central axis. On axillate tree, clusters may be to 1 ft. long, while those on the staminate are much shorter. Fruit a coarse pod to 10 in. long and to 2 in. wide, containing seeds that are to $\frac{3}{4}$ in. long and embedded in a dark, sweet pulp through the winter.

Wood, 43 lb. per cu. ft., hard, strong, coarse, dark-red, very durable in contact with soil, with thin light-colored sapwood, rarely attacked by insects. Seeds, 200-300 per lb., with high vitality and slow germination. Leaves may be poisonous to cattle; pools of water into which pods have fallen may be poisoned.

Wood used much as fence posts where it is available, also in cabinetwork and in general construction. Tree used as an ornamental or as an oddity. Long's expedition used the roasted seeds as a coffee substitute in 1820 in Missouri, and a decoction of the pulp of unripe fruits is reputed to have some medicinal value.

Honey Locust

Gleditsia triacanthos

Tree. Height to 140 ft. Trunk to 6 ft. through. Bark to $\frac{3}{4}$ in. thick and in narrow, irregular, vertical ridges. Coarse 3-forked spines are found on the branchlets or persisting even on older wood. Leaves doubly compound, to 8 in. long, of 18-28 leaflets, dark-green above, to $1\frac{1}{2}$ in. long, pale beneath.

In woods, along hedgerows or even planted as an ornamental. Ranges from Ontario to Georgia, west to Texas, Kansas, and Michigan. It has become naturalized as an escape in many areas outside the normal range, growing well in practically all temperate climates in the world.

Flowers in clusters, from axils of leaves of previous year; the pistillate in slender clusters to $3\frac{1}{2}$ in. long; the staminate in short fuzzy clusters to $2\frac{1}{2}$ in. long. Fruit a flattened, twisted pod, to 18 in. long, with thickened margins, mahogany brown, in clusters of 2-3, with oval seeds to $\frac{1}{2}$ in. long in pulp.

Wood 42 lb. per cu. ft., very durable, bright, yellowish-brown, with darker streaks and with pale, relatively thin sapwood of to a dozen annual layers' thickness. Pollination by insects. Seeds may be collected from September to February, being shed by rolling fruits. Seeds, 3,000 per lb.; yield about 1,000 plants.

Wood used for fence rails, wheel hubs, general construction. Trees planted as ornamentals and as hedge. Seeds stratified in sand and soaked in hot water before spring planting. Cattle enjoy eating the fruits and deer, hares, cottontails, squirrels, starling, and quail are known to feed on the plant. Sweet pulp makes a good relish.

Wild Senna

Cassia hebecarpa

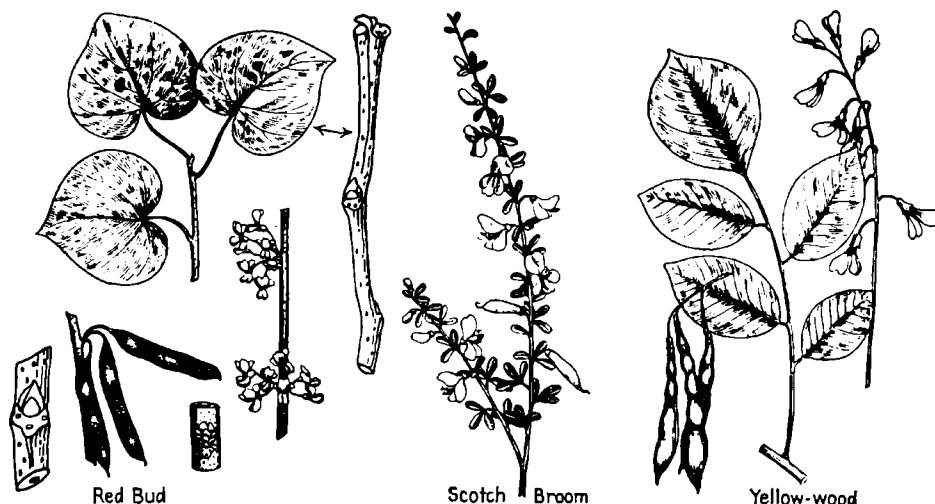
Height to 8 ft. Sparingly branched. Root perennial. Leaves compounded of 5-10 pairs of leaflets, each more or less blunt and to 2 in. long and $\frac{1}{2}$ in. wide, rounded at base, somewhat hairy, with a slender club-like gland at or near the base of the main petiole. The whole plant is only slightly branched.

Found in rich wet soil or swamps. Ranges from New England to North Carolina and west to Minnesota and Louisiana. Among the more important close relatives are *C. chamaecrista*, the partridge pea, a rather common upland weed, *C. nitida*, the wild sensitive plant ranging from New England to Florida and Arizona, and others.

Flowers in clusters of many flowers, in axils of leaves in upper part of plant, to $\frac{3}{4}$ in. across, of 5 petals almost equal to each other. Stamens, 10, of which upper 3 have no anthers. Fruit a slender, flat, at first hairy pod whose segments are as long as they are broad, to 4 in. long and $\frac{1}{4}$ in. wide. Seeds flat.

The cassia of the drugstore comes from *Cinnamomum cassia*, a tree of Egypt and India and other tropical areas, and is used in confections and as a laxative. The drug senna comes from several species of *Cassia* native of Egypt and Arabia. The leaves are collected, dried, baled, and shipped for use.

The plant is most attractive. Its flowers are a golden yellow except for the contrasting chocolate brown of the anthers. Flowering time from July through August.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Redbud, Judas Tree
Cercis canadensis

Tree. Height to 50 ft. Trunk to 1 ft. through. Branching distinctly grotesque. Twigs and branches dark, irregular, relatively slender. Leaves long-petioled, with a distinctly heart-shaped blade whose margin is entire and whose veins are conspicuous. Blade to 6 in. broad and about the same length.

Found along stream borders, on rich lands appearing as a dense forest undergrowth or slope cover. Particularly conspicuous along the mid-Mississippi region. Ranges from Ontario to Florida and west to Texas and Nebraska. 2 related species extend range to Central and Western states. 7 species from North America, Europe, and Asia.

Flowers appear before leaves in dense clusters, on stems to 1 ft. long or without stems, pinkish to purple, about $\frac{1}{2}$ in. long, pea-like. Fruit a pod, flat, slender, pointed at each end, to 3 in. long and to $\frac{1}{2}$ in. wide, falling in the autumn and freeing $\frac{1}{4}$ in. seeds.

Wood weak, hard, 40 lb. per cu. ft., dark reddish-brown, close-grained, with thin, light-colored sapwood to about 10 annual rings thickness. Seeds about 25,000 per lb., with a germination of 80% yielding some 2,000 usable plants per lb. if treated with hot water before planting in the spring.

A beautiful ornamental and a good cover plant. It does not have nitrogen-fixing nodules. Found in slightly acid, calcareous, sandy, or loamy soils. Eaten by deer and by 3 kinds of birds including bobwhite. Neither it nor its relatives have any forage value for livestock. Supposed to blush for Judas's betrayal of Christ.

Scotch Broom
Cytisus scoparius

Shrub. Height to 10 ft. Much-branched, nearly smooth, with long straight branches that are angled and erect. Leaves of 3 leaflets, the lower being petioled. Leaflets blunt, to $\frac{1}{2}$ in. long, with a compressed layer of fine fuzz and a short pointed tip. Upper leaves without petioles and smaller than lower.

Established in waste places or planted as an ornamental. Ranges from Nova Scotia to Virginia, west to California and Vancouver Island. Probably native of Europe and naturalized widely in America and elsewhere. May become somewhat of a weed by crowding out all normal competitors. Some 45 species native of Europe, western Asia, and northern Africa.

Flowers bright yellow, to 1 in. long, in long terminal leafy clusters. Calyx and supporting stem smooth. Anthers of stamens alternately large and small. Fruit a flat pod, to 2 in. long, flattened on sides and with a coiled style often remaining attached to free end, browning to black. Flowers in May and June.

Drought-resistant and will survive in salty soils or will grow on sand or clay. Considered as in part parasitic on oak roots but this is not a necessary relationship. Seeds 65,000 per lb. Propagated by seeds soaked in hot water before planting in spring or by cuttings merely stuck into the ground.

An ornamental or a weed, depending upon the use made of the soil in which it grows. Has been recommended for restoration of soil. Can be eliminated relatively easily by burning over. Recognized as a valuable soil anchor, particularly in the West. Leaves considered poisonous to livestock but are usually avoided. Eaten by bobwhite, cottontail, and California quail.

Yellowwood
Cladrastis lutea

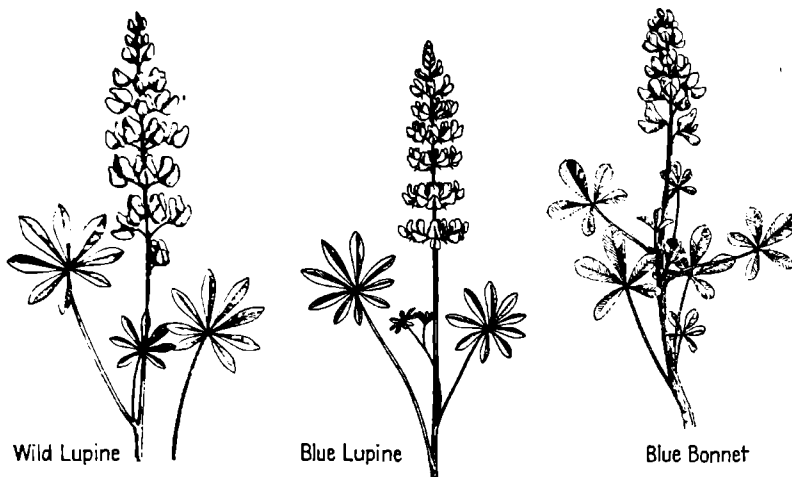
Tree. Height to 60 ft. Trunk diameter to 4 ft. Often divided rather close to ground, with spreading branches and hanging, zigzag branchlets. Leaves to 1 ft. long, of 5-11 leaflets each to 4 in. long, with terminal one usually shorter than others, turning bright yellow in autumn.

Found on limy or neutral soils. Ranges from North Carolina west to Kentucky, Tennessee, and Missouri but planted rather widely as an ornamental in New England and in southern and western Europe. Only this 1 species in the genus and it is closely related to a genus found in Manchuria.

Flowers appear in mid-June, in clusters measuring to over 1 ft. long and 6 in. wide, usually flowering every other year. Corolla white, about 1 in. long. Stamens, 10, distinct. Fruit a short-stalked smooth pod to 4 in. long and $\frac{1}{2}$ in. wide, containing from 6-20 seeds and ripening in September, falling soon thereafter.

Wood hard, 39 lb. per cu. ft., strong, yellow but changing to brown when exposed, with sapwood nearly white and thin. Ordinary propagation by seeds that are harvested in fall, stratified in sand through winter, and sown in spring. Seeds should be collected in September and October though some may be found in winter.

Essentially an ornamental tree grown for the showy flower clusters. Wood has some commercial value for use in making gunstocks. It is used as fuel and yields a clear beautiful yellow dye.



Wild Lupine

Blue Lupine

Blue Bonnet

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Wild Lupine *Lupinus perennis*

Height to 2 ft. Erect, tufted at the base, branched, rather stout and finely fuzzy in the upper parts. Roots deeply penetrating and dug with difficulty. Leaves long-petioled, to 3 in. broad, with the slender petiole bearing 7-11 leaflets that are each to $1\frac{1}{2}$ in. long and to $\frac{1}{2}$ in. wide, dark-green and widest toward tip.

Sometimes abundant in dry sandy soils particularly where there is good exposure to the sun. Ranges from Maine to Florida, west to Louisiana, Missouri, Minnesota, and Ontario. Closely related, longer podded *L. parvislorus* extends range to New Mexico and Washington, while others extend range over most of United States and adjacent territory.

Flowers alternating along terminal flower stalks in rather loose, open clusters, the whole cluster being sometimes nearly 1 ft. long. Flowers blue, pink, or sometimes white, and to $\frac{3}{4}$ in. long. Fruit a pod to $1\frac{1}{2}$ in. long, slender, fuzzy, breaking into coils and freeing 4-6 seeds. Flowering time June through July.

This plant grows in some of the poorest of sandy soils and does not thrive if transplanted to what might seem to be a more desirable environment. It grows from subterranean rootstocks that of course are not easily dug up because of their depth. The plant flowers at about Decoration Day and has been abused by flower pickers seeking bouquets.

A massed bed of this plant in full bloom would make anyone stop and look at it with pleasure. The flower is known in different parts of the country by different names, varying from the correct wild lupine to old-maid's-bonnet, Quaker bonnet, and sundial, the last referring no doubt to the response of the plant to the position of the sun.

Blue Lupine *Lupinus hirsutus*

Height to 2 ft. but often low, sometimes higher. Branches freely toward the top. Leaves long-petioled, composed of 7-9 leaflets, each to $1\frac{1}{2}$ in. long, somewhat brown, hairy, and widest toward free end. Leaflets hairy on both sides, thus differing from reddish-purple-flowered *L. hirsutissimus* with its stinging hairs.

Native of southern Europe but rather extensively grown for fodder or for garden purposes. Races of this species show color variation in the flowers from the typical blue to blue-red, red, or white flowers. The related yellow flowered *L. luteus* is, like this species, an annual and has much the same general uses.

Flowers scattered along an erect terminal flower stalk, alternate above and whorled below, blue with usually a white tip on the keel, to $\frac{3}{4}$ in. long, appearing in July and August. Pod large and hairy and developed in late season. Seeds bean-shaped, to $\frac{1}{2}$ in. long, grayish or brown and rough. Probably should not be considered as edible.

While this species is grown for fodder and for ornament, many related species are poisonous, particularly if the fruits are eaten. Of these, possibly the perennials are more likely to be suspected but this is not always true. The alkaloids lupinine and spartenine are found in *L. luteus*. Lupine poisoning may be by leaves or by fruits.

This species is planted like any animal forage crop for cutting, grazing, or plowing under as a green fertilizer. As a garden flower, it is grown as almost any common garden annual is except that it needs a fairly long season. Seed required for sowing 1 acre, $1\frac{1}{2}$ -2 bushels.

Bluebonnet *Lupinus subcarneus*

Height usually under 1 ft. Silky in some areas. Leaves long-petioled with 5 leaflets each to $1\frac{1}{2}$ in. long arising from the petiole end; smooth above, hairy beneath, the petiole exceeding the length of the leaflets, and with narrow, pointed stipules at their bases. Annual.

Common in dry open spaces in its native range, which is small and practically limited to Texas. Included here because this is the official State flower of Texas. More than 100 species of the genus in the world, of which 70 occur in North America, most of them being in the western parts.

Flowers in a short, terminal, rather open cluster, somewhat scattered, blue with a whitish or yellowish spot in the center of the standard, about $\frac{1}{2}$ in. long. Calyx hairy and with the upper lip much shorter than the lower. Fruit a pod to $1\frac{1}{2}$ in. long, hairy, and containing the seeds that are from $\frac{1}{4}$ - $\frac{3}{4}$ in. across and mottled strongly.

Western lupines, of which this is one, would make a book in themselves. They vary from tree-like *L. arboreus* and shrubby *L. densiflorus* of California to somewhat woody *L. diffusus*, deer cabbage of the East, to the great group of perennials, some of which like *L. argenteus* of the West may cause serious poisoning of sheep, cattle, and horses.

Animals poisoned by lupine may froth at the mouth, have labored breathing, become nervous, have convulsions, and die. One record shows that 1,150 sheep out of a flock of 2,500 grazed in late season died of lupine poisoning. Bluebonnets are protected for their great beauty.



Red Clover



Alsike Clover



White Clover

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Red Clover

Trifolium pratense

Height to 2 ft. Clumps of ascending stems from a deep taproot. Biennial. Leaves long-petioled, with 3 leaflets, the terminal stalkless, commonly somewhat hairy; each leaflet to 2 in. long, with or without V marking on upper side. Leaves and stems may be smooth. Stipules long-pointed. New growth comes from the crown of taproot, not from runner.

Native of Europe and Asia but widely cultivated through the United States and southern Canada. Probably was first cultivated in Spain in fifteenth and sixteenth centuries; brought from there to Flanders; in 1633, to England; probably to America about 1747. It is not popular in the Great Plains or Rocky Mountain areas but is excellent in the Northwest.

Flowers in egg-shaped terminal clusters, remaining erect as individuals after maturing. Heads about 1 in. long. Red flowers about $\frac{1}{2}$ in. long. Calyx hairy, with teeth shorter than the corolla. Honeybee's $\frac{1}{4}$ in. proboscis too short to reach bottom of $\frac{3}{8}$ in. tube, but bumblebee's proboscis is long enough to effect pollination.

Commonly seed is sown alone in spring at 8-10 lb. of seed per acre or mixed with other plants such as timothy or small grain. In South, seeding may be done in late summer. After grain crop is harvested, clover may reach height of 6 in. before winter and a good crop may be cut second spring to be followed by another later in the season.

Red clover is one of the best of the clovers raised for hay. Difficult to get seed set because of insect problems and because of weevils that may destroy the set seed. Popular varieties include June Red, Mammoth Red, Medium Red, of which Mammoth is likely to bloom late and avoid some early pests.

Alsike Clover

Trifolium hybridum

Partly reclining, smooth plant, from leaf axils appear successively new flowering branches. It does not lie prostrate nor root at joints as does white clover. The underside of leaflets is dull, not shiny as in white or hairy as in red clover. Leaflets unmarked, toothed, pale, shorter than stalks. Stipules broad, with branching veins.

Native of northern Europe and first cultivated in Sweden. Brought to America in 1839. Now grown extensively over United States and Canada but especially from Maine to Minnesota, south to Ohio River. Used as a hay, pasture, or forage plant but also as a soil enricher because of its nitrogen fixing qualities.

Flowers white to pink and turning back on the stem when mature. Appear in globular heads. Calyx much shorter than white corolla. Like white clover, the plant is a good feeding source for bees and these are necessary for pollination. Seed yield may be greater and more certain than in red clover. Each pod yields from 2-4 seeds.

Alsike seed is often sown with other clover seed or with grass mixtures with excellent results. For seed crop, from 8-15 pounds of seed are required per acre, though 4-5 may be adequate as there are about 700,000 seeds per lb. One crop may be expected the second season and this may be followed by limited grazing. Best in cool moist climate.

A good hay crop for soils too wet or too sour for red clover. Seed crops may yield to 4 bushels per acre. Roughly, digestible food ingredients in 100 lb. of clover feed are, in per cent: Protein: red, 7.38; alsike, 8.15; white, 11.46; crimson, 10.49. Carbohydrate: red, 38.15; alsike, 41.7; white, 41.8; crimson, 38.1. Fat: red, 1.81; alsike, 1.36; white, 1.48; crimson, 1.29.

White Clover

Trifolium repens

Prostrate, with no upright stalks such as are found in red, alsike, and crimson clover. Leaves of 3 small leaflets, with the free end somewhat notched and the margins definitely finely notched; undersides of leaflets smooth and glossy; petioles sometimes very long; without mucronate tips. Stems sprawling, rooting at joints; sometimes 1 yd. long and a dozen to a plant. Stipules small.

Various races from different parts of the world. Found in some form in almost all temperate parts of the world. Wild white clover is perennial, native of North America; Dutch white clover is probably native of Europe; and Ladino white clover is probably from southwestern Europe. Ladino does best on nearly neutral soils and favors much moisture.

Flowers normally in white globes but sometimes pinkish, to $\frac{1}{2}$ in. long, with corolla 2-3 times as long as the calyx whose teeth are shorter than its tube. In Ladino flowers are much larger than in other white clovers. Flowering time from May through December and when mature flowers bend back. Pods contain 2 to several yellow seeds.

Except to secure a seed crop, white clover should not be planted alone. 1 lb. of white clover added to other clover acre allotments or 2 lb. added to grass mixtures are usually suitable. Normally, 4-6 lb. per acre is best for a clear clover sowing. Seed should not be covered more than $\frac{1}{4}$ in., rolling usually providing this.

Valuable for hay, for green manure, for enriching soil, and for pasture, with varieties different in service. Dutch white may be only annual requiring new seeding. Wild white stand may last 3-6 years or even longer. Ladino White, the largest and probably best, may last 4-6 years with one seeding. White clovers improve yield and quality of associated grasses.



Crimson Clover



Fenugreek



Bird's-foot Trefoil

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Crimson Clover

Trifolium incarnatum

Height to 3 ft. Sparingly branched, covered with soft fuzz, generally erect. Leaves compounded of 3 leaflets, all arising from same point; each to $1\frac{1}{4}$ in. long, usually blunt or slightly indented at free end, with margins finely toothed and terminal leaflet stalkless. Stipules at base of leaves blunt, to 1 in. broad, thin; with toothed margins.

Found in fields and waste places or grown for ornament or as a forage or green manure plant. Introduced from Europe and established sparingly from Canada to the Gulf, sometimes temporarily elsewhere. Of some 300 species of clovers found through temperate Europe, Asia, North America, Africa, and South America, only 8 are regularly cultivated.

Flowers in rather long pointed cone-like heads that are to $2\frac{1}{2}$ in. long, with the heads single. Flowers crimson and very showy, to $\frac{1}{2}$ in. long, with the corolla equaling or exceeding the calyx lobes, the calyx being conspicuously hairy and the hairs being stiff at maturity.

Seed sown from August to October on prepared seedbed, 10-15 lb. per acre, germinates promptly and if water is present a quick stand is established. 100 lb. of good unhulled seed equals about 60 lb. of hulled. Usually seed is saved for local use but some sections such as Maryland and Tennessee produce it for sale elsewhere.

Chief use of crimson clover is for plowing under as green manure. Mature clover cut and used for hay may have hairy heads that collect in balls in stomachs or intestines of domestic animals and may cause death. Was introduced into United States in 1818. Can be considered ornamental.

Fenugreek

Trigonella foenum-graecum

Height to 2 ft. Stem erect, usually unbranched, fuzzy, heavily scented. Leaves of 3 leaflets like most clovers but with the indentations near tip obscure. Leaflets $\frac{3}{4}$ -1 in. long, with veins commonly running out into the teeth. Stipules close to petiole. Root system rather deep for an annual.

Native of western Asia and naturalized in Mediterranean region; little grown in America but commonly grown in southern Europe. Grown for flavoring in India. Some 70 related species. Name *Trigonella* means little triangle and probably refers to shape of leaflets. Best on well-drained loams; poor on clay, sand, wet, or sour soils.

Flowers white, blue, or yellow, in an obscure head. Petals free from stamens and standard rather oblong. Keel shorter than the wings. Stamens in 2 groups, of 9 and 1. Fruit a pod, to 6 in. long, slender, round in cross section or flattened, curved and with a beak, with about 16 seeds. Unlike alfalfa, pod is straight.

Requires potash and phosphoric acid for seed production; nitrogen for forage. Needs deep plowing and thorough harrowing. Sow broadcast, 10-20 lb. to acre or drill 7-10 lb. per acre, in rows 18 in. apart. Thin at 2 in. Clean culture to maturity yields forage in 4-5 months, 950 lb. per acre. Seeds flavor stock foods.

United States has imported to 310,000 lb. in a year. Seeds used as human food; in Egypt, with flour in bread; in Greece, boiled or raw, with honey; in India, with condiments; in Orient, to fatten women. Seeds not used as internal medicine but may incite thirst and stimulate drinking.

Bird's-foot Trefoil

Lotus corniculatus

Stems to over 2 ft. long, sprawling, ascending, slender, rather smooth, with many from a common root that may be exceptionally long and penetrating. Leaves of 5 leaflets, 3 of which are like a clover at tip and 2 of which are near base of a central axis. Leaflets pointed ovals, dark-green, to about $\frac{1}{2}$ in. long. Perennial.

Closely related to true clovers. About 90 species, having as a group a wide distribution over world and of course considerable variation. This species is native of Europe and Asia but is widely established in North America. Some races are much more valuable as forage than others.

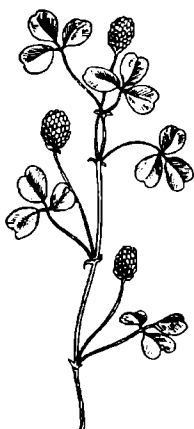
Flowers in clusters of 3-12, springing from a more or less common point, sweet-pea-like, yellow or tinged with red, to about $\frac{1}{2}$ in. long, the cluster on a stem to 6 in. long. Lobes of the calyx as long as the tube. Fruit, slender pods, to about 1 in. long, often, forming what looks like a bird's foot, hence the common name.

Probably originally entered America as a weed in ship's ballast. Established as a weed along Atlantic Coast and was considered primarily as a weed. Then it began to be used as an ornamental in rock gardens and wild gardens and finally was recognized here as an important soil builder and forage plant.

It has long been grown as a forage plant in Europe but now in America it is recognized in some types of soil as a competitor of the clovers for producing a maximum of nourishing food for cattle while contributing a maximum in enriching the soil. Proper seed for particular places must be used to get good results.



Sweet Clover



Black Medic



Alfalfa

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Wild Sweet Clover

Melilotus alba

Height to 10 ft. Erect, freely branching, smooth or nearly so, rather tough when mature. Leaves of 3 leaflets, of which 2 lower seem to be stemless, fragrant when crushed or dried. Leaflets narrowed at base, with whole margin shallowly cut, each to $1\frac{1}{2}$ in. long, may fold so that surface exposed is reduced, with mucronate tips. Root a deeply penetrating taproot.

Native of Europe and Asia but widely established in America and common as a weed or grown as a crop throughout most of the United States. Related yellow-flowered *M. officinalis* seems to be less abundant though it is more common in the Middle West than in the East. Its leaflets are less inclined to be blunt.

Flowers in delicate slender "spires" at ends of branches, erect, numerous, and to 4 in. long. Flowers themselves are white, to $\frac{1}{4}$ in. long, fragrant, and with mature ones at base of spire. Fruit a pod about $\frac{1}{8}$ in. long, bearing a single oval yellow seed somewhat like a flattened pea. Annual or biennial.

Does best on soils rich in lime but succeeds on poor soils. Excellent as a bee forage plant and the root systems serve well as soil anchorage in erosion-control practices. About 20 lb. of seed are required for sowing 1 acre. Outdoorsmen frequently strip seeds from weed tops and sprinkle them on waste bare land to help give game cover and soil anchor.

Where grown as a hay crop, it may yield very well the second year or may provide good early grazing if cattle are accustomed to eating it. Known commercially as Bokhara clover. It harbors nitrogen-fixing bacteria and so enriches the soil as well as holds it. Poets speak of "the spiring of sweet melilot."

Black Medic, Yellow Trefoil

Medicago lupulina

Sprawling by means of prostrate stems that are to 2 ft. or more long and many from a central root system. Roots at the joints. Leaves petioled, dark bluish-green, of 3 leaflets, each with conspicuous veins and shallowly toothed margins near the tip. Leaflets to $\frac{3}{8}$ in. long, narrowed or rounded at the base, capable of folding. Stipules with toothed margins.

Native of Europe and Asia; naturalized widely in all temperate areas but not in extreme cold north nor so abundant in tropics. Not easily confused with its close relative alfalfa nor with less closely related but larger flowered yellow clover. Often covers dry waste spots to exclusion of all other plants.

Flowers in small compact almost spherical heads that are to $\frac{3}{8}$ in. long. Flowers to $\frac{1}{2}$ in. long, yellow and crowded. Fruit nearly smooth, curved into a partial spire, conspicuously veined, 1-seeded and decidedly black, giving rise to common name black medic. Flowering time from July through September.

Plant does some service as a soil anchor and as an enricher of soil because of its nitrogen-fixing nodules. Its seeds have been used as deliberate adulterant of red clover but with new recognition of grazing value of better varieties, particularly in the South, this has discontinued. Legislation and inspection of course have assisted in this.

Probably serves best if sown in grass mixtures suitable to local situation. Then it can help feed the grass and be kept from clinging too close to the ground; thus being available to grazing animals. Since it is either a biennial or an annual, it is important that one be familiar with the seed one is buying. It is known as "nonesuch."

Alfalfa

Medicago sativa

Height to 3 ft. Erect or partly sprawling, branched, more or less smooth, arising from a crown. Leaves compounded of 3 somewhat petioled leaflets, each to 1 in. long, with slightly toothed margins particularly toward free end, with narrowed bases and mucronate tips. Root system a long, coarse taproot with numerous side branches.

Native of Europe but naturalized through most temperate parts of the world. Established in waste places from New England to Virginia, west to Minnesota, Kansas, and even on to Pacific Coast. Important varieties include the Grim and the Variegated. Some 50 species of the genus, about a dozen of which are of some commercial importance.

Flowers in dense, short, terminal clusters, violet or purple, with petals about $\frac{1}{4}$ in. long and with yellow stamens capable of being "tripped" by a visiting insect and thus effecting pollination. Fruit pod, elongated into 2-3 spirals containing several olive-green seeds. Pod slightly fuzzy. Seeds have peculiar knob near one end.

Seed sown in new fields may need inoculation with bacteria. Sow 12-20 lb. per acre in deep well-drained loam, with ample potash and phosphorus, usually about July, on weed-free soil to a depth of $\frac{1}{2}$ -2 in., with or without nurse crop. If new crop turns yellow, clip back to 6 in. high. Good stands yield from 1-10 cuttings a year for many years.

Excellent forage plant, soil restorer, soil anchor, bee plant that is fairly free from insect and fungous pests. Hay should be cut just as plants come into bloom and should be protected from rain. For cattle, alfalfa provides excellent food for blood, bones, and nerves, good food for muscles, and fair food for energy. It is a good source for vitamin A and fair for vitamin B.



Gorse, Furze, Whin



Prairie Turnip



Wild Indigo

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Gorse, Furze, Whin *Ulex europaeus*

Height to 6 ft. Stiff, tangled, striped shrub that is fuzzy when young and smoother when old. Leaves reduced to mere scales or narrow and fuzzy, to $\frac{1}{2}$ in. long and prickly, making branches and whole plant a mass of spines and an almost impenetrable tangle. Evergreen. Underground system suitable for soil anchorage.

Native of western and southern Europe but established somewhat in North America, particularly along Atlantic Coast from Massachusetts to Virginia but also on West Coast on Vancouver Island and in California. Some 20 species recognized in eastern Europe, of which this is probably the best known.

Flowers in clusters of to 3, or singly in axils of leaves but crowded toward ends of branches, bright yellow and fragrant, to $\frac{3}{4}$ in. long, with calyx only slightly shorter than corolla; individual stalks of flowers very short. Fruit a small, flattened, few-seeded pod, dark-brown, fuzzy, over $\frac{1}{2}$ in. long.

Flowering time, May through July, when plant may be attractive and serve as a source of nectar for bees. A double-flowered, sparsely spined variety is known that has more appeal as an ornamental than the typical plant. A tangled mass of gorse provides an excellent cover for many small animals.

Found on sand, clay, loam, and other soils and makes a superior soil anchor since it can survive burial in sand and can exist in salty water. It is not accepted by stock as fodder, probably because of spines. Makes excellent fuel of almost explosive qualities. Plant figures in many nursery stories of European origin.

Prairie Turnip, Pomme Blanche *Psoralea esculenta*

Height to $1\frac{1}{2}$ ft. Stem erect, stout, slightly branched. Whole plant, covered with a dense felt of whitish hairs. Large spindle- or turnip-shaped root or cluster of roots, about size of a hen's egg, whitish inside but with thick tough brown outer covering. Leaves of 5 short-stalked leaflets, each to 2 in. long and to $\frac{3}{4}$ in. wide.

Native of the plains areas from Manitoba through North Dakota, Nebraska, and Missouri to Texas, west to Montana. About 120 species in the genus widely distributed over the world, with at least 2 dozen in United States of which this is probably the most interesting though not necessarily the most common.

Flowers in spikes to 3 in. long and half as thick, bluish, with individual flowers with bluish petals about $\frac{3}{4}$ in. long, almost equaled by calyx bracts. Fruit a small pod to $\frac{1}{8}$ in. long, smooth, wrinkled, and hidden by calyx tube. Flowering time, June. Fruiting time July and later.

Reported to have played an important part in solving food problem of early travelers in range of the plant. Indians harvested the roots, stored them, and ate them raw, ground, baked, boiled, roasted, or made into cakes. Digging done usually in August after the top had died down.

Cultivation of the plant for food has been investigated, but it cannot compete with potato which can be grown in the same range. Fresh root flesh tastes something like a flat chestnut. Common names include Cree potato, tipsin, prairie potato, Missouri bread-root, prairie apple, pomme de prairie.

Wild Indigo *Baptista tinctoria*

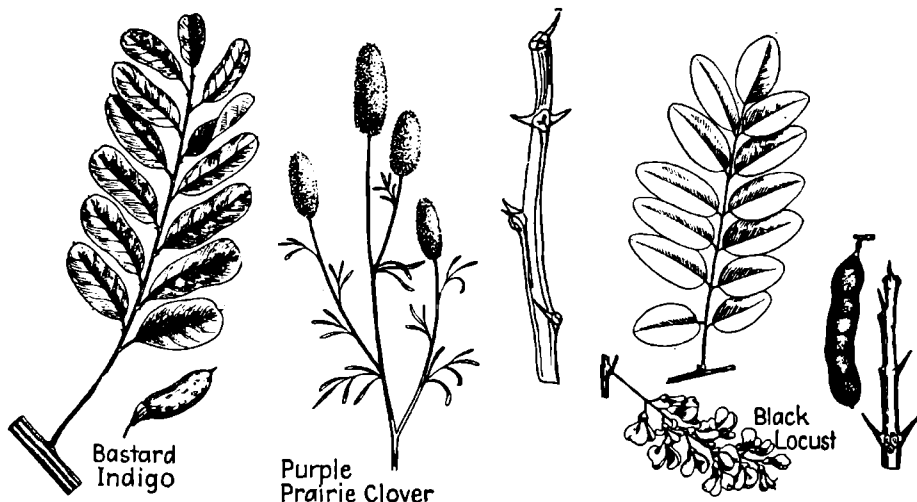
Height to 4 ft. Branched, somewhat juicy, erect, smooth, rather pale green herb. Leaves with 3 leaflets, each bluntly rounded at the free end and broadest toward tip, entire, turning black with age, to $1\frac{1}{2}$ in. long and about $\frac{1}{2}$ as wide. Root system substantial and perennial.

Found in dry soil from Maine to Florida and west to Louisiana, Minnesota, and Ontario. About 2 dozen related species found in eastern and southern North America of which this one and blue-flowered *B. australis* are sometimes grown for ornamental purposes. Other species have flowers of different colors.

Flowers in few-flowered clusters at ends of branches, on short individual stems. Flowers bright yellow, to $\frac{1}{2}$ in. long, obscurely pea-like. The many flower clusters on a single plant are conspicuous. Fruit an oval pod, long-pointed at each end, to $\frac{1}{2}$ in. long and much longer than supporting calyx tube.

Flowers appear in June and through to September; visited by syrphus flies, butterflies, and honeybees, leaf curter and other bees, of which *Halictus* is possibly an important pollinator. Does best on high, dry, loose sandy soil, often existing free from much competition. Root has a rather distinctive and permanent dye.

Root is used sometimes as a source of dye material. Roots and herbage are used as a source of some medicines. Herbage may cause some poisoning to animals if they graze on it. Probably its most interesting use is as an ornamental in wild-flower gardens.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Bastard Indigo
Amorpha fruticosa

Shrub. Height to 20 ft. Smooth or somewhat fuzzy, branched but with tip pointing upward for the most part. Leaves compound, of 11-25 thin leaflets to 2 in. long and nearly 1 in. wide, entire and grayish-green, rather conspicuously veined, short-stalked.

Ranges from Pennsylvania to Florida, west to Saskatchewan, Colorado, and Chihuahua. Escaped from cultivation elsewhere. Some 15 related species found in North America and Mexico with *A. canescens* being frequently rather conspicuous in the South.

Flowers in slender, spike-like clusters to 6 in. long. Individual flowers to $\frac{1}{2}$ in. long, violet-purple, pea-like, with corolla to 3 times as long as the supporting calyx tube. Stamens extend beyond corolla and may appear conspicuously yellow against the blue. Fruit a smooth, 2-seeded, $\frac{1}{2}$ -in. pod.

Plant commonly grows along streams or on embankments. It makes an attractive ornamental particularly when it is in bloom. About 60,000 seeds per lb.; germination of 65% give 10,000 usable plants per lb. of seeds. Plant does well on limy soils, favoring sun but surviving in shade.

Plant may be slightly poisonous to stock that graze on it. Bobwhite are known to feed on the fruits and the plant gives good cover for game. Recommended as a soil anchor for use along stream banks and popular as an ornamental.

Purple Prairie Clover
Petalostemum purpureum

Height to 3 ft. Erect, branching at tip, smooth or slightly fuzzy, a clean green. Leaves clustered, short-petioled, of 3-5 leaflets, each narrow and to $\frac{3}{4}$ in. long and $\frac{1}{4}$ in. wide, pointed at tip and narrowed at base, short-stalked, with terminal 3 leaflets coming from an almost common base.

Found in plains and prairie country. Ranges from Indiana to Texas and west to Colorado, Saskatchewan, and Manitoba. About 50 closely related species found in United States, Canada, and Mexico, some having white flowers while others are pink, purple, or blue and with foliage either smooth or fuzzy.

Flowers in rather stout, compact, cylindrical spikes that are to 2 in. long and about $\frac{1}{2}$ in. thick. Individual flowers violet or purple and to $\frac{1}{4}$ in. long, pea-like but with keel and wings rather uniformly oblong. Calyx densely gray and silky, providing an attractive background for the brighter petals.

Roots usually long and deeply penetrating, providing the plants with moisture when many near-by plants may have become withered. It probably never becomes a weed and is so attractive when it is in bloom in July and August that many persons may wish to transplant it. It does not survive cultivation.

Plant may be grown as an ornamental in gardens and is frequently popular in this way. It deserves more protection than it gets in its natural setting. The related white-flowered prairie clover *P. candidum* is almost as attractive as this species.

Black Locust
Robinia pseudoacacia

Tree. Height to 80 ft. Tall, cylindrical, irregularly branched. Trunk to 4 ft. through. Bark dark reddish-brown with squarish scales. Roots shallow, tough, yellowish. Twigs slender, with buds hidden in swellings and with short stiff thorns. Leaves alternate, compounded of 7-10 small oval green margined leaflets.

Common on rocky high grounds. Ranges from New York to Georgia, west to the Ozarks but planted and naturalized widely east of Rocky Mountains and to some extent in Great Basin. Introduced into Germany in 1601. Now probably the most widely distributed of native North American trees. Up to 3,500-ft. level in the Appalachians.

Flowers white, pea-like, in loose open clusters, with the standard of the flower large, rounded, turned backward, and scarcely longer than the wings and keel. Fruit a flat brown dry smooth pod, to 4 in. long, and $\frac{1}{2}$ in. wide, containing 4-8 seeds, each about $\frac{3}{4}$ in. long, dark-brown, and like flattened hard peas.

Wood 46 lb. per cu. ft., hard, strong, greenish-brown with yellow sapwood, durable, close-grained, swells and contracts little in changing moisture content and so is used much in making wooden nails or pins. Roots hosts to nitrogen-fixing bacteria so tree enriches the soil. May grow to 4 ft. a year in youth. Has many galls and fungous diseases.

Used as a soil anchor and enricher. Hardy street tree that yields some trash. Fragrance of flowers popular. Grown in managed forests for posts, railroad ties, telephone-pole arms because of speed of growth and durability of wood. Roots, leaves, and bark poisonous if eaten. Seeds eaten by bobwhite, deer, and rabbits.



Wisteria

Milk
Vetch

Tick Trefoil

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Wisteria

Wisteria sp.

Japanese (*floribunda*), with 7-9 pairs of leaflets; Chinese (*sinensis*), with less than 7 pairs of leaflets and flowers over 1 in. across; silky (*venusta*), with silky leaves; American (*frutescens*), with flowers less than 1 in. across. Most have stout woody climbing trunks. Probably Japanese is the most popular.

Do well in dry sandy soil but better on deep rich ground. Common names indicate parts of world from which different species come, the silky wisteria coming from Korea and Japan. American wisteria ranges from Virginia to Florida and west to Texas with a smaller flowered species (*macrostachys*) from Illinois south.

Flowers of *W. floribunda* violet to blue, pea-like, in long, drooping clusters with a hairy calyx whose upper 2 teeth are broad and flat. *W. sinensis* blooms later in the season; it may form great drooping clusters from the ends of the branches, the clusters often being over 1 ft. long. There are double varieties but they are not hardy.

Usually rather difficult to transplant so that a vigorous growth can start soon. Highly temperamental about blooming and some plants never seem to bloom no matter what treatment is followed. May be started by cuttings of wood, by root cutting, by top grafting established roots. When grown from seeds do not normally "come true" in all respects.

One of the most popular of the ornamental woody plants grown against buildings or alongside porches. May be vigorous enough to climb to top of building 4-5 stories high and hardy enough to grow almost anywhere in the United States. Pruning back to short spurs every year is recommended or abundance of bloom.

Milk Vetch

Astragalus distortus

Height to 15 in. Much-branched and with many stems arising from a common deeply penetrating root system. Mostly smooth but with some scattered hairs. Leaves compounded of 11-25 leaflets, each to $\frac{1}{2}$ in. long, rounded at tip, entire and narrowed at base, usually opposite each other and not greatly crowded.

Common in dry soil from West Virginia to Mississippi and west to Texas and Iowa. Some 1,500 species of which *A. bisulcata*, *A. convallarius*, and *A. pectinatus* are important locoweeds of the West. Of these, last ranges from Kansas and Nebraska west through Colorado, Alberta, and Saskatchewan. It has narrower leaflets.

Flowers purple, to $\frac{1}{2}$ in. long, in short loose spike-like clusters that reach about as high as the leaves and are few-flowered. Calyx tubular, with teeth about equal. Fruit a pod that is not stalked in calyx tube, slightly inflated, strongly curved, grooved on one side, slender and to $1\frac{1}{2}$ in. long. Flowers appear in March through July.

The genus is most important because of locoweed danger to cattle, being particularly bad on soil containing selenium. Dried green parts of plants may be fatal to horses and cattle, making them drag their feet, become dull and listless, and finally die. Gum tragacanth used in medicine and in calico printing comes from *A. gummifera* of Eurasia.

Horses suffering from locoweed poisoning are treated with 22 cc. of Fowler's solution daily in grain or in water while cattle are given $\frac{1}{2}$ g. of strychnine hypodermically in the shoulder daily for 30 days. It is strange that plants of a given species may be poisonous if grown over selenium soils and harmless over other soils.

Tick Trefoil

Desmodium glutinosum

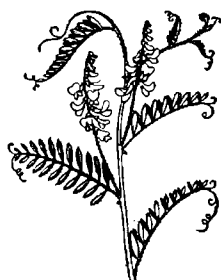
Height to 5 ft. Openly branched. Stems slender, erect, smooth or slightly fuzzy. Leaves clustered near the upper parts, with petioles to 6 in. long; composed of 3 leaflets, each to 6 in. long, nearly round but with pointed tips, entire margins, green on both sides. Perennial from a substantial root system.

Relatively common in dry open woods. Ranges from Quebec to Florida, west to Louisiana, Oklahoma, Kansas, South Dakota, and Ontario. About 160 species in the genus native for the most part of North America, South America, Africa, and Australia with about 40 in the southern part of the United States.

Flowers large, purple, with 2-lipped calyx and pea-like petals, 10 stamens fastened together at their bases; flower cluster, open. Fruit looks like a pea, with each seed surrounded by a conspicuous lobe of the pod, the sections breaking apart and sticking to objects by means of a covering of fine sticklers.

Blooms through June to September. Pollination effected by honeybees and similar small bees, many being in the genus *Halictus*. Seeds disseminated by becoming attached to clothing or to wool of animals and being carried some distance until they drop off or are otherwise removed. Fruits may tangle long wool rather badly.

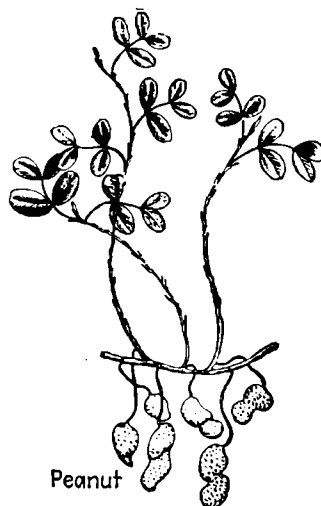
Probably of little economic importance but rather well known because of portions of fruits that cling to the clothing of those who wander through the woods in fall or early winter.



Hairy Vetch



Japanese Clover



Peanut

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Hairy Vetch
Vicia villosa

Height to 4 ft. but usually sprawling, crawling, or climbing. Finely fuzzy all over stems and leaves. Leaflets 8-24, opposite, narrow, to nearly 1 in. long about $\frac{1}{8}$ as wide, whole leaf ending in paired, twisted, tendril-like structures. Annual or biennial.

Cultivated for fodder and sometimes established as an escape from such treatment. Native of Europe and Asia. Closely related *V. cracca* or cow vetch is a perennial that is smoother and native from Newfoundland to New Jersey and west to Iowa, Washington, and British Columbia. About 130 species in the genus widely distributed.

Flowers about $\frac{3}{4}$ in. long, violet-blue or sometimes white, in 1-sided clusters arising from the axils of the leaves, pea-like. Stamens in groups of 9 and 1. Fruit a pod, to 1 in. or less long, pale green, smooth, containing 2-8 small black smooth nearly globular seeds.

Vetches grown for fodder and for enrichment of the soil. When sown for hay, for winter cover crop, or for soil improvement, 1-1 $\frac{1}{2}$ bushel of seeds are sown per acre, usually in mixtures with oats or beardless wheat. Sown for green manure, the combination is usually with rye. Often sown in orchards to help soils.

The green seeds of some vetches are eaten in Europe as we eat green peas. In South, vetches are sown on Johnson grass sod and cut the following summer, the vetch reseeding itself by the time Johnson grass is ready to be cut and eventually improving yield as well as soil.

Japanese Clover
Lespedeza striata

Height to over 18 in., sprawling or reaching upward. Tufted, much-branched, with some closely pressed fuzz. Leaves of 3 leaflets about equal to each other, rather blunt-tipped, each to $\frac{3}{4}$ in. long and to $\frac{1}{3}$ in. wide, narrowed at base and almost stemless; with margins entire, partly hairy.

Found in fields and meadows from Pennsylvania to Florida, west to Kansas and Texas. Naturalized from China and Japan but rather widely established. Of some 40 species native of Asia, Australia, and North America, nearly half are found in North America. This species is most commonly cultivated.

Flowers in clusters of 1-3, relatively inconspicuous, with or without petals, in axils of leaves, pink or purplish, with about $\frac{1}{2}$ in. corolla. Calyx smaller than the pod, which is oval, pointed, 1-seeded, and to $\frac{1}{10}$ in. long. Related *L. japonica* has pure white flowers. Our species flowers through July and August.

Does well on sandy soils and serves to enrich these more or less sterile soils by adding nitrogen and humus. Best grown with Bermuda grass in the South. Since it recovers quickly from close grazing once it has become established, it is a good forage plant. Sow at rate of 15-25 lb. per acre.

On good lands Japanese clover will produce excellent hay but it may be necessary to reseed either by sowing seed, by leaving uncut strips, or by cutting early and leaving recovered crop to produce seeds for succeeding year. Most seed is produced in Louisiana and Mississippi. Known as "hoopkoop plant."

Peanut, Goober, Groundnut
Arachis hypogaea

Height to 20 in. 2 plant types recognized; a vine and the bunch-nut type. Stems branched, slightly hairy. Leaves of 4 leaflets, each to 2 $\frac{1}{2}$ in. long, blunt or short-pointed, entire, without tendrils, rather smooth and green. Root system spreading; underground stems bear flowers at intervals.

Native of Brazil but carried to Old World by Portuguese explorers and brought back to Virginia by African slaves. One of the South's most important crops. Not grown extensively on a commercial basis much north of Washington, D.C. It does best on sandy and loamy soils. It is grown for forage and soil building to the North.

Flowers yellow, in close spikes of 1-3 flowers which appear at first above ground where immature fruit is enclosed in calyx. Flowers then thrust underground by plant and there matured. Fruits are almost too well-known to need description but consist of 2 dry shells usually enclosing 2 oblong seeds.

Plants cannot survive frosts and tops to be fed should be harvested before frost. Plants grown in crop rotation to enrich soil, as forage for hogs, food for man, and as source of fats and oils of commercial value. 1 lb. of peanuts yields 2,700 calories of food, as contrasted with 900 for 1 lb. of beef.

At least 20 kinds recognized. Peanut oil cold-pressed from seeds is used as salad oil, as olive-oil substitute for packing sardines, while seeds pressed with heat are used in soaps, lubricants, and as illuminants. The cake residue is one of best of stock foods. Many important plastics are basically peanut oil.



Groundnut



Hog Peanut



Soy Bean

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Groundnut, Wild Bean

Apios americana

Height to 10 ft., climbing over other plants and twining extensively. Juice milky. Leaves of 5-7 or sometimes 3 leaflets, each with rounded base and rather entire margins, to 3 in. long and pointed at tips. Root system a necklace-like series of tubers on a long winding axis, each to 3 in. through.

Relatively common in thickets and damp places from New Brunswick to Florida, west to Texas, Kansas, Nebraska, Minnesota, and Ontario. About 5 species in the genus of which 2 are from China and 1 in the Himalaya region. Of the 2 species in eastern North America, *A. tuberosa* alone has any wide range outside Kentucky and Tennessee.

Flowers brownish-purple, pea-like, strongly scented, to $\frac{1}{2}$ in. long, pollinated by honeybees and similar insects, borne in rather loose clusters along a central axis arising from axil of a leaf, held more or less erect. Stamens 10, with 9 in one group. Fruit a straight pointed 3-in. pod, like a slender bean.

Reproduction essentially by tubers or by seeds. Tubers may be eaten raw or peeled, scalded, roasted, or boiled like potatoes or cooked with other foods. They may be dried and stored for use in winter. Seeds may be prepared for use like peas. Many prefer tubers and seeds to cultivated potatoes and peas.

Beautiful enough to serve as an ornamental for foliage and flowers. Was used by early settlers as a basis for bread. Asa Gray considered it one of the most important native American tubers. Pilgrims used tubers as food the first winter. Whittier in "The Barefoot Boy" speaks of "Where the groundnut trails its vine."

Hog Peanut

Amphicarpa bracteata

Slender vine, to 8 ft. long, twining about plant supports to form tangled masses. Stem clothed in fine brownish hairs. Leaves of 3 leaflets, each to 2 in. long with rounded bases and pointed tips, thin and rather light green. Root system perennial, bearing subterranean flowers near the surface.

Common in rich damp rather open woodlands. Ranges from New Brunswick to Florida, west to Louisiana, Nebraska, and Manitoba. Only 2 of the 7 species found in America, the others being natives of Asia and the Himalaya regions. It may have been encouraged by early pioneers but cannot compete with other plants.

Flowers of 2 kinds. Those above ground are pea-like, in loose hanging clusters, purplish-white, to $\frac{1}{2}$ in. long, producing pods to 1 in. long that split into spirals, freeing the seeds. Subterranean flowers, rudimentary, borne near base of stem, with few stamens but producing a pear-shaped fruit with 1 large seed.

Flowers appear through August and September. Underground fruits may be collected from mid-September through the winter. Seeds of both kinds of flowers eaten, though the underground ones are favored; they taste better than raw peanuts. Of course, underground flowers are self-pollinated.

Seeds of flowers above ground used like peas, or may be boiled into soups. Seeds of underground flowers good raw but better roasted or boiled. May be collected without destroying root system. Pioneers robbed caches of underground fruits made by squirrels. Hogs dig fruits for food.

Soybean, Soja Bean

Glycine max

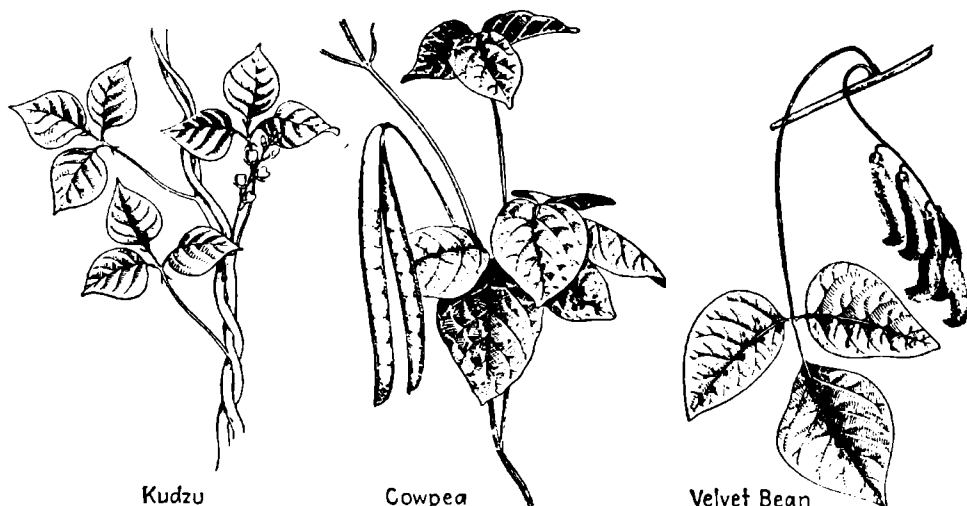
Height to 6 ft. Stems erect, stiff, hairy, with some of the side shoots more or less vine-like. Leaves compounded of 3 leaflets, each to 6 in. long, entire, about $\frac{3}{8}$ as wide as long and borne on long stems. Whole plant can form a rather dense tangle of considerable depth.

Native of China and Japan but now extensively grown in the United States. Common varieties include mammoth, Ito San, early yellow. In United States, it is grown along northern border of land suitable for growing cowpeas, namely, north of a line from Kansas to Maryland. It does well on poor soils.

Flowers inconspicuous, white or purple. Calyx hairy, with the 2 upper teeth more or less united and the standard of the corolla broad. Stamens usually fastened together. Fruit a pod that hangs on a short stalk, to 3 in. long and $\frac{1}{2}$ in. broad, brown, hairy and with 2-4 globular black, brown, green, or yellow seeds.

Does best on warm well-drained loam, planted in drills $2\frac{1}{2}$ -3 ft. apart or in hills to 20 in. apart, cultivated frequently in early stages until ground is shaded, then cut for hay or for silage, cut and threshed for seed, or plowed under for green manure. Often grown in orchards for enrichment of soil.

Seeds have a variety of uses including food for man or beast, roasted or baked or ground into meal or made into soups. Industry uses great quantities for plastics, paints, and other materials. Seed required for sowing an acre is 2 pecks if in rows and 4 pecks if broadcast. Often sown with sorghum or cowpeas. Contains little starch.



Kudzu

Cowpea

Velvet Bean

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Kudzu Vine *Pueraria thunbergiana*

Woody vine. Perennial. With 3-4 vines per crown and roots penetrating to depth of 12 ft. Vine may be over 100 ft. long for 1 year's growth. Leaves of 3 leaflets, with leaflets not lobed deeply, with entire hairy margins. Roots large, tuberous, and starchy. Vines may grow 1 ft. a day on good soil in good weather.

Native of China and Japan but introduced rather widely and established through the South and as far north as Philadelphia, though it may winterkill badly in northern limits. The related *P. tuberosa* and *P. phaseoloides* are cultivated variously in the South, the latter being introduced into United States in 1911.

Flowers pea-shaped, purple, borne late in the season in the axils of the leaves, in spikes that are not particularly showy. As the flowers are borne on the older parts of the plant, they may not appear abundantly in the northern part of the range. They are from $\frac{1}{2}$ - $\frac{3}{4}$ in. long, fragrant and produce large, flat, hairy pods bearing many seeds.

Propagation by cuttings of roots or leaves or by seeds. 500 crowns may be enough for 1 acre planted 1 to every 85 square ft. Bare ground at 140°F. may be kept as cool as 89°F. if covered with kudzu, with corresponding reduction in loss of moisture. Roots fleshy and yield a good grade of starch; bark contains a fiber suitable for weaving into cloth.

May yield $3\frac{1}{2}$ tons of hay a year. Dried leaves make good fodder, fair breakfast food, and good chicken feed. Leaves produce a rich litter equal to forest litter. Excellent soil anchor, and ideal for restoring worn-out soils, particularly in exhausted parts of the South, as it adds to nitrogen content of soil. Has good ornamental value.

Cowpea *Vigna sinensis*

Height to 18 in. or trailing as a vine depending on the variety. Vines may be several feet long. Leaves of 3 leaflets, each to 6 in. long, entire or faintly angled, with the older ones commonly short-pointed and nearly as wide as long. In general, the herbage looks like that of the ordinary garden bean.

Probably native of Asia, having been under cultivation in southeastern Asia for better than 2,000 years. It has been widely introduced in warmer parts of the world coming to the West Indies in the seventeenth century and to the United States in the eighteenth. Still an important crop particularly in China and India.

Flowers pea-like, greenish-yellow, on long stalks. Stamens 10, in groups of 9 and 1 and usually opening in early morning, closing by noon and falling in the afternoon. Fruit a slender pod to 1 ft. long, not flabby or inflated when green, hanging and bearing seeds that are to $\frac{1}{2}$ in. long and of many colors and shapes.

Seeds about size of a navy bean are fed to cattle and poultry or even used by man as a coffee substitute. Plant cannot survive frost. Seeds planted in drills at 5 pecks per acre; in rows, at 3 pecks; and broadcast, at 8 pecks. When grown for hay, commonly harvested in September and cured 2-3 days as cut.

One of better plants for restoring nitrogen to soil. Hay is rich in protein. Where plants are allowed to mature seeds, hay or straw is less valuable as food for cattle. Cowpeas may be pastured easily. A common rotation is cotton, corn with cowpeas, winter grain planted after corn, and then cowpeas.

Florida Velvet Bean *Stizolobium deeringianum*

Vine with length to 100 ft. or more and with exceptional twining ability, somewhat white and velvety. Leaves compounded of 3 leaflets, of which the terminal one may be smallest; the largest, to 6 in. long and $\frac{3}{4}$ as wide, with wider portion away from leaf center; entire and definitely velvety beneath.

Native of Asia and probably of Malaya but widely planted and thriving along our Gulf Coast and in Florida where it may be raised for forage. Grows reasonably well as far north as Virginia and Kentucky, but north of that the season is not long enough for it to reach maturity. Of about a dozen species, 3 are of economic importance.

Flowers from 5-30, borne in a long hanging cluster with each flower purple, to $1\frac{1}{2}$ in. long, with a whitish calyx having a broadly triangular upper lip. Fruit a pod to 3 in. long, stiff, ridged, with a black velvety covering containing 3-5 somewhat flattened but plump speckled, streaked, or dark seeds.

Requires about 110-130 days from planting to reach maturity but will produce vines sufficiently robust for use as fodder or green manure in a shorter time. Commonly planted with corn, which provides a support for the vines, sometimes on a basis of 2 rows of corn and 1 row of velvet beans, although this decreases the corn yield.

Vines too coarse for cutting as ordinary hay, but a field grown to corn and velvet beans may be used as pasture and grazed with considerable profit to the cattle. Vines provide good soil anchorage and serve to restore nitrogen to the soil. The related *S. pruriens* is known as "cowitch" because of stinging hairs on pods.



Lentil



Sweet Pea



Garden Pea

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rosales. Family Leguminosae

Lentil

Lens esculenta

Height to 1½ ft. Profusely branched, lightly fuzzy. Leaves compounded of 2 to many pairs of alternate or opposite leaflets, totaling to about 14, each to ½ in. long, slender or narrowly oval. Leaves usually end in short tendrils 1 to each leaf. Roots bear nodules of importance in soil building.

Native of southeastern Europe, where it is grown much more commonly than in America. About a half-dozen species in the Mediterranean region and in southwestern Asia of which only this one is of any great economic importance. They favor dry sandy soils to the richer loams.

Flowers in clusters of 1-3, on slender stems, small, being about ¼ in. long and the calyx sometimes enclosing the white or pale blue corollas. Fruits are short broad pods which contain 2 flattened seeds round in outline, convex on both faces, and greenish-brown or some other dark color.

Seeds sown in drills in March, in lines 1½-2½ ft. apart. Plants require little attention once they are planted. Seeds are frequently preyed on by a weevil. Herbage makes good fodder for cattle or may be plowed in for green manure. Seeds do not keep well after being removed from pods.

Name lens refers to shape of seeds. Seeds used mostly in lentil soup; cheaper than beans or peas and about equally nutritious. Esau is reported to have sold his birthright to Jacob for a "mess of pottage" made from red lentils.

Sweet Pea

Lathyrus odoratus

Height to 4 ft. or more. Weak-stemmed, climbing by means of tendrils at ends of leaves. Stems roughly hairy, flattened into wings. Leaves of 2 narrow oval leaflets, each of which is to 2 in. long and ½ in. or more broad. Branched tendrils at end of leaves.

Native of Italy. Over 100 species in the genus, some being annuals and some perennials, most of them found native in Northern Hemisphere but some in South America. About 2 dozen more or less standard garden flowers in the group that are grown for cut flowers or for ornament.

Flowers 1-4, in clusters that are held erect on stout stems reaching above the leaves. Flowers to 1 in. long; sometimes to 2 in. broad, frequently and originally purple, now found in many colors. Fruit a pod about 2 in. long bearing several nearly globular gray-brown seeds.

Annuals require a rather rich deep soil planted early and so arranged that soil about roots is kept relatively cool. To help in this, seeds are often planted in trenches under wire; as plants grow older the earth is filled in around the roots. Dwarf sweet pea known as "cupid" does not climb.

Justly one of most popular of garden and hothouse flowers because of daintiness of flowers and excellence of fragrance. Flowers should be cut rather than plucked from their rather strong stems, to avoid injury to plants. Perennial sweet peas have long fleshy roots and are long-lived.

Garden Pea

Pisum sativum

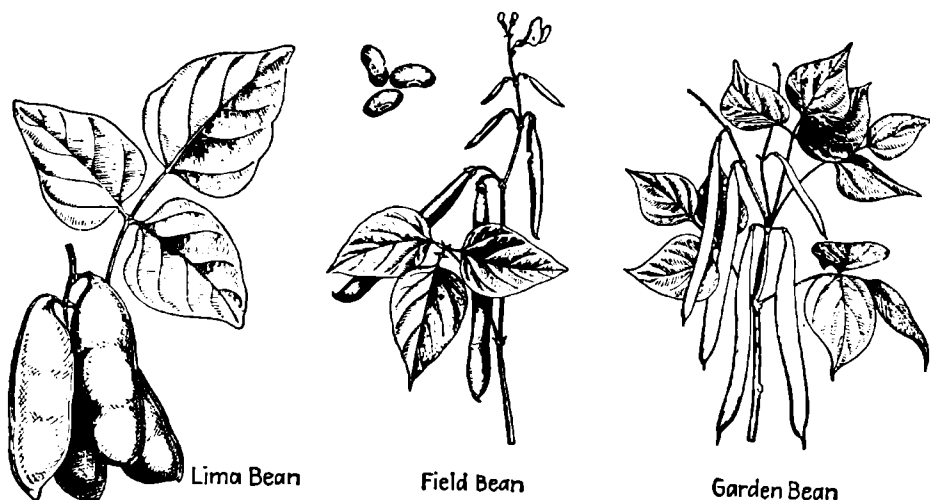
Height to 6 ft. Climbing vine. Smooth and rather dark green. Leaves compounded of paired leaflets and ending in a branched tendril, with large leaf-like stipules at base of leaves. Leaflets to 2 in. long and about ¾ as wide, entire. Whole plant more or less succulent.

Native of Europe and Asia. Now widely cultivated in temperate countries. Field peas *P. sativum* var. *arvense* have bluish or lilac flowers and are raised for angular seeds. Sugar peas *P. sativum* var. *saccharatum* are raised for their juicy, somewhat fleshy, edible pods.

Flowers few, usually about 2 in a cluster, on ends of rather long stems arising from axils of leaves, white. Fruit a pod that easily splits into 2 parts, is to 4 in. long, and contains 2-10 nearly globular sweet green seeds that become wrinkled or smooth when ripe.

Peas for canning are sown in fields in drills in rows of 12-30 in. apart. About 50-100 seeds in 1 oz., and ½ pt. should plant a row to 80 ft. long, which will give enough peas for a small family for 10 days. Best to plant at intervals of 1 week to keep a new crop coming into maturity, planting first very early.

Canned peas are a staple food for households almost the world over and their production makes a major agricultural industry. Field peas that become too tough for use as "green peas" are sold as "split peas." Marrowfat peas are popular because of their size and sweetness, but usually smaller peas are sweeter.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rosales. Family Leguminosae

Lima Bean
Phaseolus limensis

Pole lima beans may be vines to over 10 ft. long. Velvety, with thick coarse leaves that have 3 leaflets each, possibly to 5 in. long and often 3 in. wide, with thick texture, long points, and rounded bases. Related sieva bean *P. lunatus* is of bush type and is smoother, with thinner leaves and smaller leaflets.

Native of tropical America. Most extensively cultivated in California. There are small-seeded lima beans, and large-seeded limas, and bush and pole forms. Lima beans are grown mostly in the frost-free parts of the South and shipped to Northern markets for sale. Potato lima beans are of the small-seeded type.

Flowers of the lima bean with slender calyx bracts about $\frac{1}{2}$ as long as the calyx; of the sieva bean, with oval, strongly veined calyx bracts. Fruit a broad, flattened, thick, heavy pod to 3 in. long and 1 in. wide with thick margins, containing large plump white seeds.

Lima beans require 120 days free from frost to mature successfully and should not be planted until the soil is well warmed, so are unreliable as a northern crop. The bush types of course require more space than do the pole types.

Seeds are rich in protein and starch, are good tissue builders and energy developers. They equal lean meat in many qualities, and if pork is added, provide an excellent balanced ration. Because proteins in beans are in thick-walled cells, prolonged cooking is preferred method of preparation.

Field Bean
Phaseolus vulgaris

Types include pole or climbing and bush, dwarf, or bunch forms. True dwarfs include the red kidney bean and the short-vined navy bean. Climbing field beans are not common or popular in gardens. Annuals. Leaves compound, with rounded leaflets, entire and to 6 in. long.

Probably native of South America. Domesticated by Incas and used by Indians north into North America before arrival of white man. Beans have been grown in Europe and elsewhere since the discovery of America. Field beans include white and red kidneys; white, red, and yellow-eyed marrows; white mediums; and navy or pea beans. 200 species.

Flowers much as in the garden bean. Seeds planted after frost danger, 1-2 in. deep, 4-6 in. apart in rows or hills 2 ft. apart, at 70 lb. per acre. May yield harvestable crop in 60-80 days, as contrasted with 100-130 days for usual field bean. Fruits are handpicked when ready for use.

Anthraxnose is a bad fungous pest, and plants are subject to a bad bacterial wilt. Insect pests include a weevil that attacks the fruits and seeds and a leaf beetle. Food value of green string beans is about 190 calories per lb. with 7% carbohydrate, 2% protein, and a little fat, or much lower than in fresh or dried field beans.

Green beans are good for vitamin A, good for vitamin B, and excellent for vitamin C, in these respects being better than field beans usually are. Snap beans and string beans provide basis for a big industry in fresh foods and canning.

Garden Bean
Phaseolus vulgaris

Types include pole or climbing and bunch or dwarf, with the climbers more popular in garden than in field varieties. Stems of climbers may be many feet long. Leaves compound, with leaflets to 6 in. long, pointed and rounded at base. Garden beans grown for many purposes, each demanding a different type of fruit.

Like the field bean, garden bean is native of America and one of some 200 species and of many varieties. Popular dwarf varieties are Dwarf Horticultural and Goddard, and popular pole type is Horticultural. Popular green-podded snap bean is Stringless Greenpod. Popular bush wax bean is Golden Wax bean. Common canning form is Refugee.

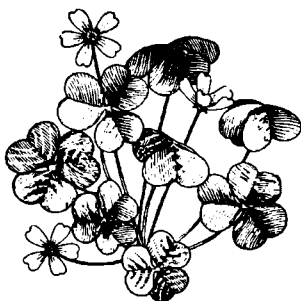
Flowers white, cream, red, or violet, with prominent broad calyx bracts, equaling the calyx. Seeds planted in rows to 36 in. apart at $\frac{1}{2}$ bushel per acre with navy beans, after soil is warm and frost danger has passed. Should not be cultivated when leaves are wet. Plants are harvested, stacked, dried, and threshed and seeds are stored.

Dried navy beans yield 1,560 calories per lb., 22% protein, 60% carbohydrate, 2% fat as contrasted with 720 calories, 30% carbohydrate, and 9% protein from freshly shelled beans. Plants make excellent forage and trash is fed to stock. Fruits mature poorly in soil that is rich in nitrogen or too wet. Many insect and fungous enemies.

Beans rank high as source of protein and starch in man's food and serve well as tissue builders and as source of energy. Baked beans are a good substitute for lean meat. Served with salt pork to add fat, they make a well-balanced diet. Preparation requires long and adequate cooking.



Flax



Yellow Wood Sorrel



Wood Sorrel

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales

Family Linaceae

Flax

Linum usitatissimum

Height to 4 ft. Stems under $\frac{1}{8}$ in. in diameter, commonly divided at or near base into 2 or more nearly equal branches that are themselves unbranched until near the top. Leaves narrow, simple, to $1\frac{1}{2}$ in. long. Best fiber comes from long, slender unbranched stalks and from inner bark of unbranched stem.

Under cultivation since time of early Egyptians and earlier Chinese while a closely related species, *L. perenne*, was used in Europe in Stone Age. Flax is now cultivated throughout Europe except in the Balkans, and in Siberia, China, Japan, Australia, East Africa, Chile, Canada, and the United States.

Flaxseed, weighing 56 lb. per bushel, is sown for fiber at $1\frac{1}{2}$ –2 bushels per acre; for seed, at 2–3 pecks per acre preferably on fertile clay loam. Seed broadcast or drilled, and soil is then rolled so that it is buried to a depth of $\frac{1}{2}$ –1 in. Crop matures in 75–100 days. Flowers blue, $\frac{3}{4}$ in. broad, delicate.

Fineness depends on thickness of stand and uniformity of growth, so drought or other weather conditions may affect quality. Fiber flax is pulled by hand, an acre being average day's work. Seeds threshed out. Stems retted in water 10–20 days, or in ground 3–6 weeks, then wood is broken and fiber scutched, baled, and marketed.

Yield may vary up to 700 lb. of fiber per acre. Used in making linen. Grown for seed, matures in 100 days. In United States, about 3 million acres yields about 31 million bushels of flaxseed worth about 58 million dollars or about equal to yield of peanuts, barley, potatoes, buckwheat, sugar beets, or grapes. Used as food and for extracted oils. Cattle may be poisoned by soaked linseed cake.

Yellow Wood Sorrel

Oxalis corniculata

Height to 6 in. Branched above, erect, smooth or sparingly hairy, arising from a buried horizontal rootstock that gives rise to a number of erect stems. Leaves many, long-petioled, of 3 more or less heart-shaped leaflets that droop or fold variously, each leaflet being to $\frac{1}{2}$ in. wide and about the same length.

Native of warm and tropical parts of Old and New World. Found wild as far north as Ontario. Common in greenhouses throughout the world as a not too aggressive weed. Does best on dry or moist but not too wet soil. About 300 species in the family and over 50 in the genus, a half-dozen often being common in a locality.

Flowers in loose open clusters of 2–6, each on a slender stem joined with the stems of other flowers. Flowers pale yellow, to $\frac{1}{2}$ in. broad; produce somewhat cylindrical yet pointed fruits that split along vertical lateral lines expelling the many small brown seeds. Fruits usually on stems that have become reflexed.

Flowering time from February through November or through year in greenhouses and in protected areas. Pollination usually by syrphus flies, small bees, or even by some small butterflies though self-pollination is possible. Leaves contain oxalic acid, as family and genus names imply.

As a field weed, easily controlled by persistent cultivation and crop rotation. Leaves eaten by hikers or used sparingly in salads, though it is unwise to eat them in too large quantities. Underground runners are much tougher than stems above ground and persist when weeds are pulled by hand.

Wood Sorrel

Oxalis acetosella

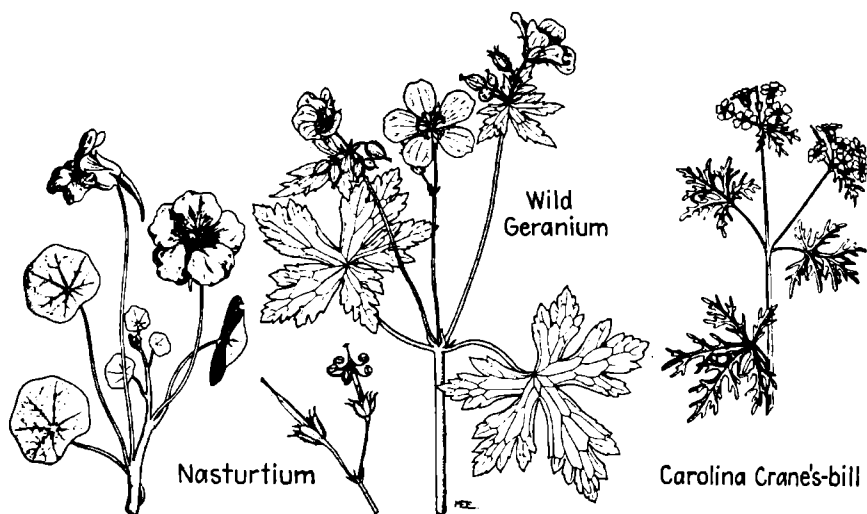
Height to 6 in., arising from a sprawling, branched or unbranched, scaly rootstock that roots along its length. Erect stems branched little if any, with sparse brownish hairs. Leaves 3–6 per stem, to 4–5 in. long, with 3, broad heart-shaped leaflets at the end, each being wider than long and conspicuously veined.

Native of North America, Asia, Europe, and Africa and found most commonly in damp, acid, cool woodlands, being relatively common from Nova Scotia to North Carolina, west to Saskatchewan and north shore of Lake Superior. Its rather fragile daintiness seems in keeping with the nature of the environment in which it grows.

Flowers nearly 1 in. across, pinkish or white with pink or red stripes, color being deepest in the center of the flower where there is usually a small solid dark area. Tips of the 5 petals are rather conspicuously notched and there is usually only 1 flower to a branch. Fruit to $\frac{1}{4}$ in. long, smooth, with 1–2 seeds per cavity.

Some flowers do not open but mature fruits underground near the base of the stem. Pollination may be effected by small bees and by syrphus flies. Flowering time from May through July, depending to some extent on area and season. Plant yields what druggists call "salt of lemons" though this does not make it of commercial importance.

A frail, beautiful low plant with many names including cuckoo-meat, sour trefoil, shamrock, stubwort, sleeping clover, ladies'-clover, sleeping beauty and sheep sorrel. It cannot be easily confused with the more common yellow sorrels, which are more inclined to grow in open places. May be eaten sparingly as a salad.



PHYLUM SPERMATOPHYTES. CLASS DICOTYLEDONEAE

Order Geraniales

Family Tropaeolaceae

Nasturtium

Tropaeolum majus

Strong, climbing or twining, succulent smooth pale green stems, often a number of feet long. Leaves with round blades borne at ends of long, usually upward-curving petioles, with margins somewhat angled and frequently with evidence of a spiral leaf miner. Roots fibrous.

Native of Peru, Colombia, and Brazil but commonly cultivated in greenhouses throughout United States or in open in summer months. Usually grown as a mass garden border plant. It has been in cultivation in Europe since 1685. Some 45 species of vines or weak spreading plants native from Mexico to Peru.

Flowers solitary, showy, to $2\frac{1}{2}$ in. across, yellow, maroon, orange, white, variegated, blotched or otherwise colored, with a long spur to the rear that ends in a nectar-bearing area. Petals rounded. Sepals, 5. Stamens, 8. Ovary, 3-celled, each flower producing not more than 3 seeds. Annual.

Large seeds germinate in about 8 days, live 3-4 years. Plants bloom 2 months after seeds are sown and continue until killed by frost. Pollination by insects. Sow seed in rows about 1 ft. apart after danger of frost is past and thin plants to 9-12 in. apart. Keep weeds down and keep soil loosened. Flowers should be picked daily.

A useful ornamental for garden or commercial greenhouse. Plant lice may be controlled by nicotine solution, cabbage worm by lead arsenate spray, leaf miners by picking and destroying affected leaves. Leaves often used in salads and young seeds are sometimes preserved as pickles. Produces few flowers if soil is too rich.

Wild Geranium, Crane's-bill

Geranium maculatum

Height to 2 ft. Branched or unbranched, particularly above, erect, fuzzy, arising from a thick coarse rough rootstock. Basal leaves with long petioles and blades more or less round but deeply cut or almost divided into 3-5 parts that may be obscure. Stem leaves, 2, opposite, short-petioled.

Found in woodlands or on shaded rocky hillsides from Newfoundland to Georgia, west to Alabama, Nebraska, and Manitoba. Sometimes found in rather exposed places among weeds along roadsides but probably persisting from a cutover woodland area. Nearly 200 species of geranium, with about 60 being found in North America.

Flowers rose-pink to magenta or purple, in loose, open clusters of relatively few flowers, to $1\frac{1}{2}$ in. across, with the 5 sepals pointed-tipped and the 5 petals woolly at the base. Pistil develops a fruit to $1\frac{1}{2}$ in. long that splits vertically from the base, hurling seeds by a unique sling technique. Seeds with curving lines on surface.

Flowering time from April through July. Pollination is effected by honeybees, other small bees, and commoner syrphus flies. Self-pollination practically impossible because stamens mature much before pistils. Flowers wilt quickly when picked and therefore make poor bouquets.

Common names include stork's-bill from the appearance of the fruit, chocolate flower and shameface from the color of the flower, rockweed from the site favored, and alumroot or alumbloom from the nature of the rootstock.

Family Geraniaceae

Carolina Crane's-bill

Geranium carolinianum

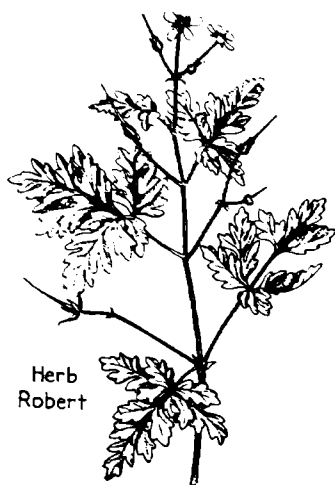
Height to 15 in. Erect, fuzzy-stemmed, grayish, branched, and relatively stout from a coarse rootstock. Leaves long-petioled, with blades round or kidney-shaped in general outline but deeply and conspicuously cut into about 5 segments, each of which in turn is rather deeply cut to form a coarse lace-like appearance.

Found on poor soils in woodlands or in the open and often among rocks from Nova Scotia to Florida, west to British Columbia and Mexico as well as in Bermuda and Jamaica. This is one of the more common wild geraniums of the South, replacing the larger flowered *G. maculatum* of the north.

Flowers pale pinkish or magenta to white, in more or less compact clusters at ends of branches. Each flower to $\frac{1}{2}$ in. across, with petals $1\frac{1}{2}$ times the length of sepals. Stamens, 10, all fertile. Pistil, fuzzy below, developing into a fruit that is to 1 in. long, sharp-pointed, and bearing fine curving marked and pitted seeds.

Flowering time from April through August. Pollination may be brought about by visits of small bees or syrphus flies or it may be self-pollinated, since pistils and stamens may be mature at the same time and may contact each other. It cannot easily be confused with the larger, coarser *G. maculatum*.

Probably of little economic importance but in regions of abundance may be reasonably well-known. Apparently has relatively few common names. Distinguishing characters are the small flowers rather crowded into clusters, the branched nature of the plant, and the inch-long fruit that is fuzzy below.



Herb Robert



Dove's-foot
Crane's bill



Stork's bill

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales. Family Geraniaceae

Herb Robert

Geranium robertianum

Height to 1½ ft. Weak, sprawling to erect, freely branched to form a rather ball-like mass, strongly scented, covered with somewhat sticky hairs. Leaves finely, finely cut and divided, with sections blunt-tipped and in 3-5 somewhat obscure parts the divisions frequently being twice-divided. May turn bright red in fall.

Found in rather open rocky woodlands, in crevices in gorges or sometimes in and from Nova Scotia to Pennsylvania and west to Missouri and Manitoba. Also found in Europe, Asia, and northern Africa. Rarely found in exposed sunny places and does best where moisture is good.

Flowers to ½ in. across, reddish-purple, with the petals entire about twice the length of the 5 sepals and narrowed at base. Fruit nearly 1 in. long with a long slender point, splitting from base to free smooth seeds suddenly a considerable distance. Fruit almost smooth.

Flowering period from June through October, making it one of later blooming of larger geraniums. Some botanists place it in genus *Robertiella*, in part on basis that leaves are divided rather than parted and that parts of pistil are shed rather than persistent after seeds are shed.

This is a conspicuous late summer and fall woodland plant, blooming close to the ground when white snakeroot is blooming well above the forest floor. Particularly attractive late in the season when whole plant may appear a flaming red.

Dove's-foot Crane's-bill

Geranium molle

Usually has weak sprawling stems to 18 in. long, branching, hairy. Leaves long-petioled, with blade nearly round in general outline but cleft nearly to the middle into as many as 11 lobes, each of which is further divided into 3-5 shallow lobes at the tip. Hairs of the plant relatively soft.

Native of Europe but widely established in America, being found in Pacific Northwest of Washington and Vancouver and in East from Maine to Pennsylvania west to Ohio and Ontario. It probably will spread rather widely as its seeds may be found in seeds of commercial lawn grass that may be shipped almost anywhere.

Flowers dark purple, to nearly ½ in. broad. Sepals, 5, blunt and not bristle-tipped but very hairy. Stamens, 10. Fruit, with cross wrinkles and beak nearly ½ in. long, with some hairiness, splitting to free smooth seeds that lack pits and wavy markings though there may be straight lines on them.

This rather pretty little weed is often found growing among lawn grasses, low enough to be passed over by a lawn mower and yet not sufficiently aggressive to crowd grass out over any considerable area. Not so conspicuous in the early season as later, when it mars the uniformity of a grass lawn.

Many common names have been given for this geranium, among them being dove's-foot crane's-bill, culverfoot, pigeonfoot, probably referring to the general appearance of the fruiting area, and starlights, referring to the flowers.

Alfilaria, Stork's-bill

Erodium cicutarium

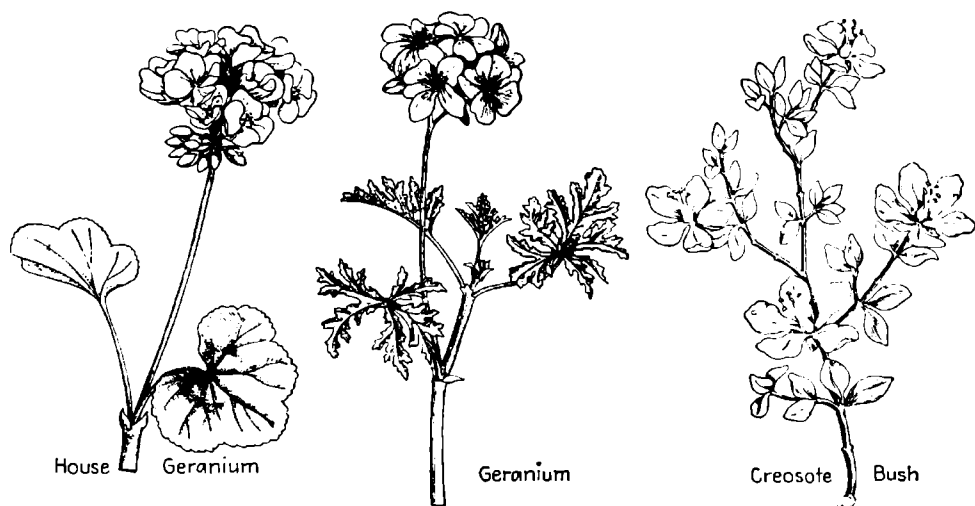
Height to 1 ft. Branched and tufted, densely fuzzy, somewhat sticky. Leaves to 7 in. or more long, finely and profusely divided and subdivided, the upper leaves being without petioles and the lower with rather long petioles; whole plant arises from substantial underground structure.

Native of the Old World where it is a common weed. Found in America on lawns, in fields, and in waste places from Nova Scotia to Pennsylvania west to Oregon and Texas, being more abundant in western part of this range than in the eastern. It may be spread through agency of seeds.

Flowers borne in rather small, compact to 12-flowered clusters at ends of stems arising from stem tips or leaf axils. Flowers purple to pink, to nearly ½ in. across. Stamens, 5 instead of the usual 10 found in the geraniums, but with some sterile filaments. Fruit a slender beak to 1½ in. long, breaking at the tip.

Flowering time April through September. Annual or biennial. Reproduces largely by seeds but persists by means of root system, which must be destroyed if an established plant is to be eliminated. May successfully crowd out lawn grass or the less aggressive field plants.

Control is by digging out roots once a plant has shown itself or by shallow cultivation, inducing seeds to germinate before a crop is planted and then following with clean cultivation of crop. Common names include wild musk, pin clover, pin grass, pinweed, and heron's-bill, mostly based on character of fruit.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Geraniales

Family Geraniaceae

Geranium

Pelargonium hortorum

Height may reach 15 ft. or more but in potted plants is usually about to 30 in. Stem stout, branched, and becomes woody if old unless killed by frost. Roots freely at joints. Leaves with round or kidney-shaped blades, to 5 in. across, with coarsely scalloped edges, soft-haired and pungently fragrant. Roots fibrous.

Native of South Africa but grown widely through world as a hothouse or a bedding plant. Among more popular varieties are the white, Mme. Buckner; the red, Red Barney; the brick red, Red Fiat; the light pink, Enchantress; and the salmon, Fiat or Mme. Landry. In mild climates the plants are perennial.

Flowers normally appear in late winter but may be induced at any time of year; borne many in a cluster on a long stalk arising from axil of upper leaves. Open flowers turn downward. Single varieties have 5 petals and 6 sepals but double varieties have many petals. Fruit long, slender, of 5 parts.

Requires soil high in phosphate and potash. In beds, apply 20% superphosphate at 10 lb. and 1 lb. potassium chloride to 100 sq. ft. Cuttings set in June 1 ft. apart. Too much nitrogen makes plants too succulent. Best soil temperature 50–70°F. Buds show about 4 weeks before blooms are at their best. Normally avoid watering the leaves.

Among the most popular pot plant and bedding plant species. May be propagated from stems or leaves since either roots readily in water. Plants may be cut back and used 2–3 winters. Never use fresh manure as a fertilizer for geraniums. A serious disease is leaf spot caused by overwatering and poor ventilation.

Rose Geranium

Pelargonium graveolens

Normally seen as a pot plant, or in greenhouses or flower beds. Usually under 3 ft. high. Branches freely and when old the stem becomes woody. Roots fibrous. Leaves with blades nearly heart-shaped, and with 5–7 deep lobes which have smaller lobes; long-petioled, rose-scented. Perennial except where killed by frosts.

Native of South Africa but widely grown under cultivation wherever man desires an ornamental flower or a decorative foliage plant. *P. graveolens* commonly cultivated in France and Spain and *P. odoratissimum* in Florida, Texas, and California for commercial purposes indicated below.

Flowers, in general, similar to *P. hortorum* but narrower, with the petals rose or pink and with the 2 upper and larger of the 5 petals commonly purple-veined. Fruit long, slender, and 5-valved. Flowers and leaves should not be wet and general culture is similar to that outlined for *P. hortorum*.

Stem cuttings are commonly started in sand in summer, covered with glass until rooted, then shifted to soil. Requires much sun, good drainage, and little nitrogen. Common diseases include leaf spot and blackleg; worst insect pest is Mexican mealy bug, the last being controlled with Lethane 440.

Geranium oil extracted from *Pelargonium* is a common adulterant or substitute for oil of roses used in making soaps and perfumes. The oil is extracted by distillation for the most part from the leaves, and industry associated with its production may develop into something substantial in the United States.

Family Zygophyllaceae

Creosote Bush

Larrea divaricata

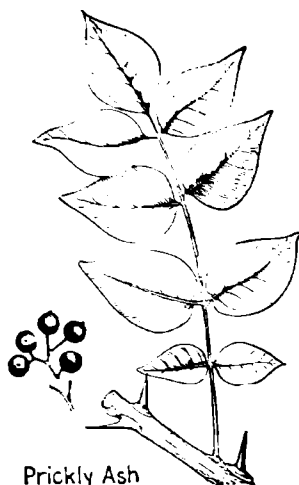
Height to 10 ft. or stunted to 2 ft. Leaves evergreen, fragrant, particularly when wet, conspicuously dark green with a protecting varnish of resin making a conspicuous contrast when associated with the almost black stems that are slightly swollen at the joints.

Found on light desert soil marking line between upper and lower division of Lower Sonoran life zone rather definitely. One of most widely spread and conspicuous of desert plants of North America. In Mohave Desert, it is found in pure stands over wide areas and is low in the Panamint Valley.

Flowers large, yellow, appearing suddenly with first appearance of the rains in April and May; and with almost equal and surprising suddenness they produce the furry white fruit balls that drop in later summer, at which time plant becomes essentially dormant until new spring rains come.

Sweet scent of creosote bush adds flavor to food cooked over fire made of it. Leaves yield a medicine thar, in Mexico at least, is used in treating wounds, burns, rheumatism, tuberculosis, and stomach troubles.

Galls on the bush may be caused by the gall midge *Asphondylia*. These appear as conspicuous walnut-sized swellings. Used by man in land classification as an index that, unless irrigated, land bearing the plant has little or no value for grazing livestock. Associated with gray burro bush, *Franseria dumosa*.



Prickly Ash



Wafer-ash, Hop Tree



Gas Plant

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales. Family Rutaceae

Prickly Ash

Zanthoxylum americanum

Shrub or tree, reaching a height of 25 ft. and trunk diameter of 6 in. Branches armed with prickles at bases of leaves and with orange buds in winter. Leaves alternate, of 11 leaflets, each being dark-green above and lighter beneath, to 2 in. long, pointed at tip and almost entire.

Found in woods, wet swamps, and thickets, from Quebec to Virginia and west to Kansas and South Dakota with the related *Z. clava-berculis* extending range to Florida and Texas. At least 150 species of the genus to be found rather widely distributed in temperate and tropical parts of the Old and New Worlds.

Flowers greenish, minute, in loose ball-like clusters borne at axils of leaves, flowers themselves lacking a calyx and having 4-5 petals that spread to make a flower only about $\frac{1}{10}$ in. across. Flowers borne before the leaves appear, on wood that was developed previous year. Fruits 2-seeded, black.

Wood light, brown, soft, weighing 35 lb. per cu. ft. Leaves, like those of the related oranges, are aromatic when crushed but plant has no particular use either for ornament or for the production of useful oils or other products. Flowers in April and May.

Not an economically important species. It may add something to the impenetrability of swampy lands and the spines on the twigs may not be pleasant when they strike bare skin, but there do not seem to be any poisonous or medicinal properties to give the plant importance. Known as toothache tree, suterberry, and angelica tree.

Hop Tree, Wafer Ash

Ptelea trifoliata

Tree or shrub. Reaches a height of to 25 ft., with a maximum trunk diameter of 6 in. Twigs and branches spineless but bark bitter and strongly scented. Leaves alternate, composed of 3 leaflets, which when young are downy and pointed, to 5 in. long, with the side leaflets oblique.

Found in woods from Connecticut to Florida, west through Ontario to Minnesota, south to Mexico, with cultivated forms being grown rather widely outside the normal range. 3 species to be found in the United States, of which this apparently has the widest range.

Flowers about $\frac{1}{2}$ in. broad, in rather loose terminal clusters, with a disagreeable odor, greenish-white, unisexual or with both stamens and pistils; whole cluster usually rather well-hidden by leaves. Fruit a thin wafer-like structure to $\frac{3}{4}$ in. across, conspicuously veined, with small swollen oval center.

Wood light brown, weighing to 43 lb. per cu. ft. Not of economic importance. The bitter fruits are sometimes used as substitutes for hops but the plant is most commonly encouraged as an ornamental since there are a number of varieties, some with attractive, conspicuously smooth, yellowish leaves.

The common name quinine tree probably refers to the bitter taste of the bark. Other names suggestive of one characteristic or another are ague bark, swamp dogwood, prairie grub, pickaway anise, and wingseed. One cultivated form is very fuzzy while others are glisteningly smooth.

Gas Plant

Dictamnus albus

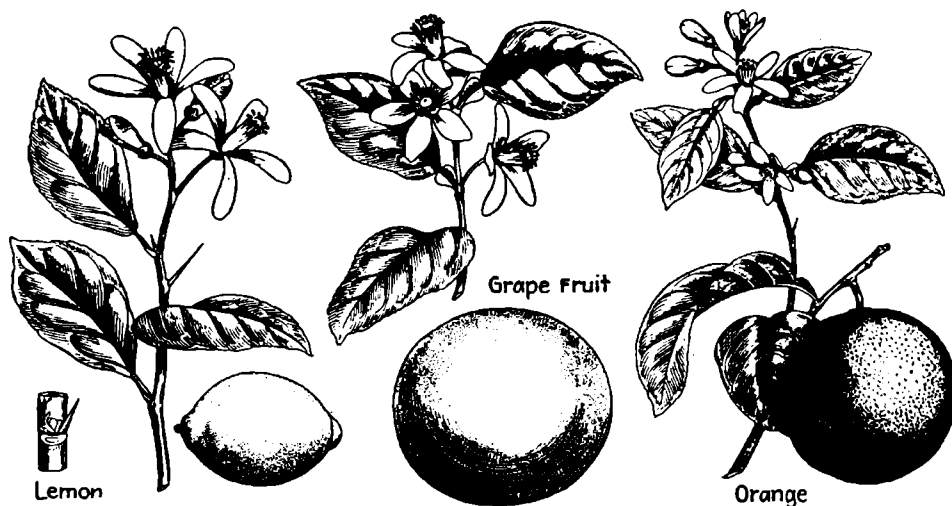
Height to 4 ft. Stem stout, bushy, forming into clumps. Leaves glossy green, alternate, composed of 9-11 egg-shaped unevenly margined leaflets, the whole plant having a strong, rather unpleasant odor. Roots exceptionally hard and heavy but may be broken to be used in forming new plants.

Native of southern Europe and northern China; while it is rather widely grown in gardens of the world it is not exceptionally common in United States. Several color races have been selected for cultivation but they are all probably merely varieties of a single species. Related to the oranges.

Flowers white, pink, pale purple, or other colors, borne in long showy clusters well above foliage. Petals, 5. Stamens, 10. Ovary, deeply 5-lobed. Whole flower about 1 in. long. Both flowers and leaves fragrant. Plant slow-growing, requiring to 3 years from seed to seed but living to through 3 generations of men.

Flowers appear in June and July. Insect-pollinated. Propagation by root division or by sowing seeds when ripe in fall, covering 1 in. deep, and transplanting the 2-year seedlings. Should bloom the third year and many years thereafter. Seeds hard to germinate. Plants not easily affected by droughts or frosts or by diseases.

Attractive as a border plant in a garden; once established may be considered permanent for a number of lifetimes. Name derived from fact that a volatile oil given off in hot, still, muggy weather may cause a gas flash if a lighted match is held near a flower. Dermatitis caused by contact with seed pods is persistent.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Geraniales. Family Rutaceae

Lemon
Citrus limonia

Relatively small tree that bears short stout stiff thorns and is relatively smooth. Leaves to 4 in. long, rather blunt, with short petioles bearing narrow margins, with a conspicuous joint between petiole and blade. Under cultivation, trees are usually kept to a maximum height of 10 ft.

Native of Asia but introduced widely throughout the world where the temperature does not go below 29°F. for any considerable period. Apparently succeeds best in the United States in California. 3 common varieties recognized. Margined rather than winged petiole separates lemon from oranges and grapefruit.

Flowers solitary or clustered in axils of leaves, pink-tinted outside and in the bud but white within, to $\frac{3}{4}$ in. long, with 20 or more stamens. Pollination by insects. Fruits oval, nipped at each end, sour, of 8-10 segments, with relatively thick spongy skin, to $2\frac{1}{2}$ in. in diameter.

Commonly grown on sour orange stock by grafting or budding. Fruit picked and packed by gloved hands throughout year but more particularly in winter months when they reach a maximum size. Lemon harder than lime, less hardy than orange, and less resistant to fungi than orange or grapefruit.

Vitamin A absent or nearly so in the fruit juice; B, present in considerable amounts; C, in large amount. Useful in flavoring many foods, drinks, and candies and to some extent medicinally. One of most important staple citrus fruits; too sensitive to cold to be raised over long periods in most of Florida.

Grapefruit
Citrus paradisi

Trimmed to a rather strong low tree, with slender rather dull spines, which are sometimes lacking. Twigs finely furry, greenish. Leaves to 6 in. long, with broadly winged petioles, those on young shoots tapering to a blunt point. Root system well-developed. Wood uniform. Bark rather close.

Native of Asia, but planted widely particularly in Florida, California, Texas, and Louisiana, on light well-drained sandy fertile soils. The Duncan is a common and popular California variety while "pinks" are favored in Texas. Different races sometimes emphasize different popular names as grapefruit, pomelo, and shaddock.

Flowers solitary or in axillary clusters with large white recurving petals and 20-25 yellow stamens, exceptionally fragrant, medium-sized. Fruit almost globular, to 6 in. in diameter, with about 12 segments, pale yellow with rather thick rind, sour, or when tree-ripened may be sweet. Related pomelo fruits, weigh to 20 lb.

Propagated by seedlings, budding, or grafting on seedling stock. Begins bearing at 3 years and reaches full bearing stage at about 10 years. Fruits held late on trees may sprout seeds and injure fruit flavor. More susceptible to cold than most other citrus fruits and grows better on poor soil than do the oranges.

Fruit rich in vitamins B and C; lower in calcium, protein, and most minerals than oranges or lemons. Introduced commercially into United States in 1809 and now one of major citrus crops of the country, particularly in Florida. Many varieties including pink-fleshed Foster and Thompson have been developed.

Sour or Seville Orange
Citrus aurantium

Tree. To 30 ft. high, with many blunt spines that are nevertheless sharp. Leaves to 4 in. long, blunt at tip usually but sometimes pointed, with petiole conspicuously and broadly winged, lustrous green, and in general waxy in appearance. Bark relatively smooth and close.

Native of southeastern Asia. Brought to Spain and there cultivated some thousands of years before the sweet orange. Stranger yet, it was brought to America before the sweet orange and was possibly the first fruit tree brought to America by the early settlers and explorers. It was spread by the Indians.

Flowers several in a cluster or single in axils of leaves, of medium size, white both in bud and when open, fragrant, with 20 or more stamens. Fruit globular or slightly flattened, about 3 in. in diameter, rough, with sour pulp and bitter dividing membranes and at maturity with hollow core.

Grown as an ornamental and as a base for grafting sweet oranges in United States since it can survive some conditions the sweet orange cannot. Name Seville orange indicates Spanish origin of fruits.

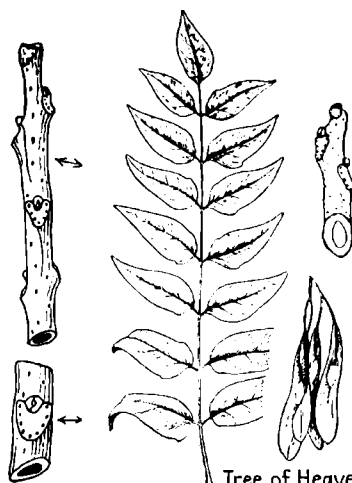
Essential oil is extracted from rind and used in perfumery and in liqueur curacao. Fruits used as food and in making orangeade and marmalade. Peels candied and used as a condiment. Vitamin and food values are much the same as those listed under sweet orange.



Tangerine



Kumquat



Tree of Heaven

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales

Family Rutaceae

Tangerine, Mandarin

Fortunella nobiles deliciosa

Good-sized tree. Leaves of mandarin variety narrower than those of tangerine and oranges and wings on petioles narrower than those on orange leaves. Leaves to $2\frac{1}{2}$ in. long, entire or finely broken margin, with mere suggestion of petiole margin. Mandarin tree smaller than tangerine.

Native of southeastern Asia but widely introduced through the world in general areas where oranges are grown. Closely related to Satsuma and King oranges. Tangerine and mandarin are variety *deliciosa* of *C. nobiles* while Jishiu and Satsuma oranges are variety *unshiu* and may have leaves to 4 in. long.

Flowers small, white, fragrant, with 8-24 stamens. Fruit reddish flattened spheres, to 3 in. in diameter, from which rinds may be peeled easily and cleanly, giving the name kid-glove orange, and in which sections are easily separated. Core hollow in variety *unshiu* and the few seeds are not beaked.

All oranges are susceptible to many insect and fungous pests including scale insects, thrips, mealy bugs, mites, gum diseases, and rots. Protection against frost effected by fires. Sprays, beneficial insects, proper fertilization, and pruning help with other problems. Appearance is important in marketing, and so culture is a serious problem.

Food value comparable to that of oranges. Tangerines do not keep well in markets and the abundance of seeds against their popularity. Frost damage makes oranges dry. Canning of oranges and tangerines not developed to the extent that grapefruit canning has progressed.

Kumquat

Fortunella sp.

Oval kumquat, *F. margarita*, a small tree, to 12 ft. high, with or without thorns. Leaves to 6 in. long and to 2 in. broad, tapering evenly at each end, paler beneath, with petiole somewhat margined. Round kumquat, *F. japonica*, has relatively broader evergreen leaves that are not commonly over 4 in. long.

Native of China whence it was brought to England by a naturalist named Robert Fortune, of the Royal Horticultural Society, of London, in the middle of the nineteenth century. In America, kumquats are hardy farther north than most citrus fruits, being found into Georgia.

In *F. margarita* flowers are solitary or in small clusters in axils of leaves, rarely over $\frac{1}{2}$ in. across and borne on short stems. Fruit to $1\frac{1}{2}$ in. long, orange-yellow, with bitter skin, acid pulp, and abundant oil glands. *F. japonica* has globular fruit, to 1 in. through, with milder skin and bright orange color.

In addition, *F. crassifolia* differs radically in that it has a sweet rind and a juiceless pulp. Grown for ornamental purposes as well as for their fruits, the edible qualities of which vary greatly with the species and with taste of prospective consumer.

Kumquats are smallest of citrus fruits. Fruits eaten whole, raw or preserved; seeds not usually extracted since they are too small to be offensive. Evergreen quality of foliage, fragrance of flowers, and hardness add to ornamental value of the plant.

Family Simarubaceae

Tree of Heaven

Ailanthus altissima

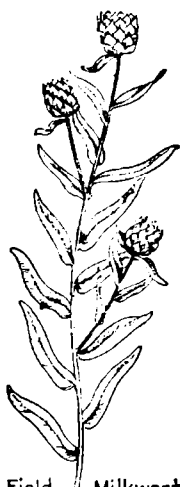
Tree. Height to 90 ft. Twigs coarse, rather smooth, brown, with large leaf scars with an upper notch half-surrounding the bud. Leaves to 3 ft. long, smooth, petioled, composed of 41 mostly opposite leaflets, each to 5 in. long, that are pointed at the tip, with obscure teeth at base, and in some with a few conspicuous glands.

Native of China but well-naturalized in eastern North America. Common in courtyards of some of our larger cities, where it seems to persist in spite of all obstacles and where it provides a welcome shade but an unwelcome clutter and sometimes odor. 10 related species and many varieties.

Flowers: staminate, small, greenish, ill-scented, with 5 petals and 10 stamens, borne on tree other than that bearing pistils, though pistillate flowers may bear some stamens also. Fruits to 2 in. long, like a small oval seed surrounded by a long twisted wing. In some varieties fruits are bright red. Fruits borne in fall.

Wood coarse-grained, weak, soft, pale yellow, not durable. Foul-smelling staminate flowers make it undesirable to allow such trees to develop in populated areas. Tree ordinarily undesirable as shade tree because of objectionable suckers but so vigorous that it survives in cities where no other tree could exist.

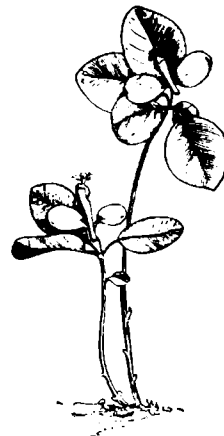
Was introduced into America as ornamental from China. May form tree with a trunk to 40 in. through. Apparently it can grow almost completely surrounded by pavement. Dermatitis from leaves is possible. May be unpleasant because of its attractiveness to ants that may feed on juices from its unpleasantly smelling leaves.



Field Milkwort



Seneca Snakeroot



Fringed Polygala

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Geraniales. Family Polygalaceae

Field Milkwort
Polygala sanguinea

Height to 15 in. Stems slender, branched above, somewhat angled, smooth, well-supplied with leaves, not arising from a perennial rootstock. Leaves slender, to $1\frac{1}{4}$ in. long, blunt or pointed but some much narrower than others, rather evenly distributed over the stem.

Found in open fields and meadows from Nova Scotia to North Carolina, west to Minnesota, Louisiana, and Kansas. Usually does best in moist sandy ground that is loose. Sometimes locally very common but in other areas most uncommon. It may be common some years and uncommon others in a given place.

Flowers in heads that form small globes or are sometimes more elongate but always crowded; rose-pink, purplish, or sometimes white or green. Wings of the flower longer than pod and rather broad for their length. An attachment to seed is in 2 parts, each of which is almost as long as seed itself. Colored part, the calyx.

Flowering time from June through September. Two forms of same species that often grow closely together or mixed. One is purple-flowered; the other green, the difference possibly being either hereditary or physiologic though intermixture indicates that hereditary influence is stronger.

Such common names as strawberry tassel, pink milkwort, purple milkwort, and others indicate that the plant has attracted attention. Apparently it has no important uses, and it yields so quickly to cultivation that it is not a pest as a weed.

Seneca Snakeroot
Polygala senega

Height to 18 in. Several erect nearly smooth, slender but rather tough stems arise from a woody horizontal rootstock. Leaves alternate, smooth, scale-like at base, but upper, to 2 in. long and to $\frac{3}{4}$ in. wide, without petioles and rather uniformly distributed over upper leaf-bearing stems.

Found in rocky woodlands or on steep sides of ravines from New Brunswick to North Carolina, west through Hudson Bay area to Alberta and south to Arkansas, being limited in southeastern portion of this range to mountainous areas.

Flowers borne on rather heavily flowered but slender long spikes at upper ends of stems, greenish-white to white, to about $\frac{1}{8}$ in. long, with wings conspicuously concave and crest of corolla short and with few lobes. Seeds hairy, slightly longer than lobes of an attachment that persists.

Flowers from May through June. This polygala bears no underground flowers such as are described for fringed polygala. Perennial like fringed polygala and unlike annual pink milkwort. Apparently there are more annual than perennial polygalas in our range.

Listed in a number of books reporting quack remedies but apparently has no recognized medicinal properties. Known as rattlesnake snakeroot, Senega snakeroot, or mountain flax, indicating that it has attracted sufficient attention to be considered a common plant.

Fringed Polygala
Polygala paucifolia

Height to 7 in. Erect or ascending, branching, arising from a perennial horizontal rootstock that is to 18 in. long. Leaves more or less clustered at top or upper portions of erect stems, with uppermost the larger, being to $1\frac{1}{2}$ in. long and nearly 1 in. wide, dark-green; the lower leaves scale-like.

Found in rich or rocky woodlands or on light soils from Anticosti Island and New Brunswick to Georgia and west to Illinois, Minnesota, and Saskatchewan. In Virginia it is found to an elevation of 2,500 ft. Some 450 species in the genus, of which about 40 are in eastern and southern United States.

Flowers of two kinds. Large showy flowers, 1-4, arising from leaf axils of upper leaves, rose-purple to wine-colored to white, with wings to nearly 1 in. long. Some small, inconspicuous flowers are borne underground on short lateral branches and do not open though they produce fertile seeds (cleistogamous).

Leaves may be confused with those of wintergreen since they have a somewhat similar color and shape though of course they lack the fragrance and flavor. This gives the plant the name flowering wintergreen. Flowers borne May and June; pollinated by honeybees and other small bees such as *Andrenidae* and *Halictus*.

An attractive woodland flower. Pollinating bees alight on a wing of the flower; their weight depresses a part of flower forcing rigid stamens and pistils to come free and contact the visitor. Visitors of lighter weight are unable to expose the essential organs so easily.



Spotted Spurge



Cypress Spurge



Snow-on-the-mountain

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales. Family Euphorbiaceae

Spotted Spurge *Euphorbia maculata*

Sprawling weed, with stems to 1 ft. long, freely branched. Covered with fine hairs, exuding milky juice freely when broken. Leaves opposite, from $\frac{1}{4}$ -1 in. long, finely toothed, with a central purple-brown spot; covered with fine hairs. Root system rather deeply penetrating, branched but not coarse.

Found along roadsides and in dry paths and waste places generally where soil is relatively poor. Ranges through North America except in far North and a few other places. Native of North America but established widely in other parts of the world. Over 4,000 species in the family and over 1,000 in the genus.

Flowers whitish, in inconspicuous clusters in axils of leaves. Both staminate and pistillate flowers are found on the same plant from June through October. Pollination by insects; in some flowers where pistils and stamens are present, self-pollination takes place. Fruits, angled pods containing three 4-angled gray pitted seeds.

Relatively free from insect and fungous pests and avoided by grazing animals probably because of milky juice. An annual reproduced by seeds that may lie dormant more than a year. Seeds probably present in most waste soil. Plants yield to competition and so rich soil is not a common habitat. Juice contains the poison euphorbon.

Persistent hoeing will keep plant down. Leaves as cover and somewhat as soil anchor in exposed waste places. Called wartweed but is more likely to cause wart-like spots than to cure warts. Juice may cause severe blisters, loss of hair, general illness, and act as purgative. Cattle may die of scours after eating some euphorbias.

Cypress Spurge *Euphorbia cyparissias*

Stems to 1 ft. high, smooth bright green, arising in large closely clustered patches from substantial horizontal perennial rootstocks; more or less branched in upper parts. Leaves slender to thread-like, the uppermost being in whorls around flower-bearing clusters, to 1 in. long; the lower, alternate and without petioles.

Escapes from gardens; established widely in cemeteries of old-fashioned type and in abandoned homestead sites. Ranges from Massachusetts to Virginia, west to Colorado but originated in Europe where it is grown commonly as an ornamental. It is most evident in America in the northeastern states.

Flowers borne in clusters at top of stems in groups whose stems often come from a common point (umbels) or arising from axils of upper leaves, usually bearing broadly oval but short leaf-like structures beneath a small flower cluster. Seed case to $\frac{1}{16}$ in. in diameter, bearing smooth oblong gray seeds.

Grown as an ornamental but rather unwisely so, as it may sometimes be eaten by cattle and may be seriously poisonous. Flowers borne from May through September, conspicuous because of yellowish supporting bracts. Quack doctors made a purgative from the roots.

Cattle eating hay containing this plant may be seriously poisoned, become weak, collapse, have scours, and die after mouth and throat become greatly swollen and eyes inflamed. Many common names include welcome-to-our-house, Irish moss, tree moss, quacksalver's spurge, cypress, kiss-me-Dick, garden spurge, balsam, and graveyard weed.

Snow-on-the-mountain *Euphorbia marginata*

Stem stout, erect, to 3 ft. tall but usually much shorter, bright green, smooth or somewhat fuzzy, repeatedly 2-forked to form a rather compact mass. Leaves many, light green to whitish or variegated, to 3 in. long, broadly oval or more pointed at the base; entire margins.

Native of region of dry soils from Minnesota to Colorado, south to Texas but introduced to the East and frequently established as an escape or as a weed where waste soil has been dumped. Grown rather commonly in some sections as a bedding plant in gardens and on steep banks where it may exclude other plants almost wholly.

Flowers small and relatively inconspicuous though the supporting bracts may be rather obvious. Flower cluster composed of 3 forked rays and margins of supporting bracts are conspicuous. Fruit like a flattened globe, to $\frac{1}{4}$ in. through, fuzzy, with rounded lobes containing round ash-colored seeds.

Flowers appear from May through October. Since plant is unusually free of insect and fungous pests, patches look uniformly healthy. Annual so can be kept in control with reasonable care. This is probably the euphorbia that most frequently causes dermatitis in humans who grow the plant as garden borders.

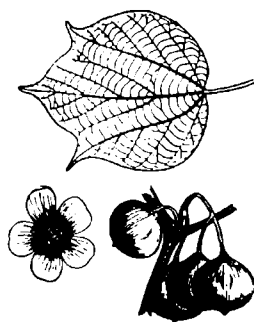
As in most euphorbia poisoning, white milky juice causes blisters and inflammation of the skin but this varies greatly with the individual and with the condition of the plant. Because of its beauty, it will probably be grown as a garden plant in spite of its poisonous properties.



Poinsettia



Croton



Tung-oil Tree.

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Geraniales. Family Euphorbiaceae

Poinsettia
Euphorbia pulcherrima

Shrub or herb. In proper climate reaches a height of 10 ft. or more. Leaves elliptical to narrower, to 6 in. long, entire or lobed, fuzzy beneath, milky-juiced and those just below flower cluster a bright vermilion red. These upper leaves are usually narrower and more entire than lower leaves.

Native of Central America and tropical Mexico. Known mostly in the North as a greenhouse plant popular at Christmastime. In some of the many forms the showy upper leaves are white, yellow, or pink rather than vermilion. Related Mexican fire plant has upper leaves blotched with red and white.

Flowers in small relatively inconspicuous green clusters at ends of stems or in center of cluster of showy leaves, with individual groups about $\frac{1}{4}$ in. across, bearing a large yellow gland on one side, and without the petal-like attachments found in some euphorbias.

After flowering, poinsettias are placed under benches 2-3 months and allowed to dry at temperature of 50-60°F. In mid-April, they are potted in new rich soil and cut back. Cuttings may be made from old plants after binding areas with wet moss. Soils should be rich, porous, and dry.

Cuttings made in morning, dropped in cool water 5 minutes, and planted in sand root in 16 days and can be transplanted in 4 weeks. Stock plants are fed urea, 1 oz. to 5 gal. of water, or ammonium sulfate 1 oz. to 2 gal. every 2 weeks. Ideal temperature is 60-65°F.

Croton
Codiaeum variegatum

Tree or shrub. Height to over 6 ft. Smooth, alternate, simple, entire, rather thick leaves that have petioles and are commonly prettily variegated in dark green and a yellowish-green or, in some varieties, a conspicuous red and green. Some varieties have leaves that are twisted spirally and otherwise.

About 6 common species native of Malaya and the Pacific Islands, with this one commonly grown in warmer climates as an ornamental or in greenhouses where outside survival is impossible. Number of varieties produced by horticulturalists is almost endless.

Flowers: staminate, in open clusters that are to 10 in. long; pistillate, borne usually separately on same plant. Fruit a whitish or light green capsule to $\frac{1}{4}$ in. in diameter. Pistillate flowers without petals; staminate bear 20-30 stamens.

Requires night temperature of 70-75°F. Cuttings are rooted from October-June with soil temperature to 80°F, or rooting may be stimulated by tying wet moss about the stem for about 3 weeks and then cutting and resetting the rooted portion. Plants require much sunlight.

Unfortunately mealy bugs and other hothouse pests thrive on crotons. These may be checked by tobacco and other common insecticides. Seeds may be ripened under glass and used for propagation. Important varieties include the yellow *Carrierei*, the red *Czar Alexander III*, and the pale yellow *Hawkeri*.

Tung-oil Tree
Aleurites fordii

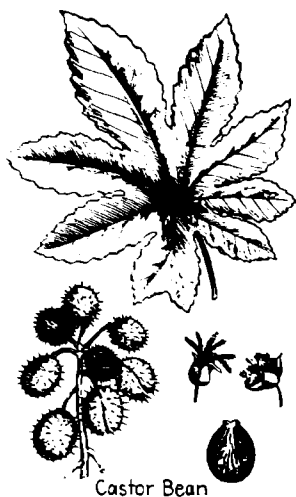
Tree. To 25 ft. high, with conspicuously smooth branches and rather like an orchard tree in general appearance under cultivation. Leaves somewhat heart-shaped at the base or 3-lobed, to 5 in. long, with a loose fuzz on the underside that vanishes with age.

Native of western and central China but introduced widely in suitable territory for cultivation, now grown in considerable acreage through Gulf Coast territory. Can thrive on relatively dry soils that are unsuitable for some other crops. Probably at best in the United States in Florida.

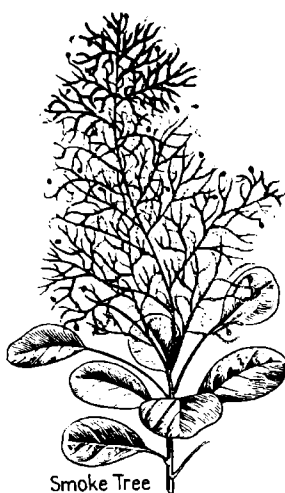
Flowers appear before leaves, in open clusters that appear reddish-white. Petals 1 in. or more long. Fruit 3-5-celled, while the fruit of the related candlenut is 2-celled. Fruit to 3 in. in diameter, smooth, with rough seeds appearing when dry like a black walnut.

Few plants have revolutionized an industry more than has this tree that produces the tung oil of commerce, efficient because it makes a hard, elastic varnish that dries more quickly than other oils and thus permits rapid production of automobiles and similar equipment.

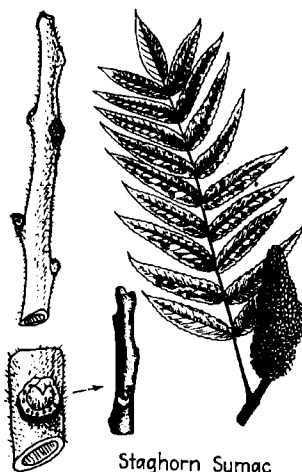
Plants begin to yield fruits when from 4-10 years old. The oil is only slightly affected by salt water and is therefore useful in painting ships. Like candlenut, the oil cake is poisonous, unsuitable for food but useful as a fertilizer. Plant known as China wood oil tree as well as tung.



Castor Bean



Smoke Tree



Staghorn Sumac

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Geraniales Family Euphorbiaceae

Castor Bean *Ricinus communis*

Tree. Reaches height of 40 ft. in suitable climate or a height of 15 ft. as an annual herbaceous plant. Leaves like great stars, thick, to 3 ft. across, lobed, smooth or with spiny structures on underside and with divisions of leaf reaching more than halfway to midrib.

Probably native of Africa but now widely cultivated in tropical and semi-tropical lands. Escaped from cultivation and sometimes established. Found in waste places from New Jersey to Florida, west to Texas. Great numbers of forms based chiefly on color of leaves, markings of the seeds, and nature of the fruit.

Flowers, staminate and pistillate borne on same plant, with staminate below pistillate. Flowers in rather open terminal clusters having numerous stamens with branched filaments. Fruit breaks into 2-3 sections freeing smooth, attractively marked seeds. Fruits conspicuously coarse-spined.

Plant grown as an ornamental in United States but in Oklahoma it is grown for the seeds, which contain from 25-40% of a thick colorless or greenish oil. Extracted oil is boiled with water and filtered to remove mucilage and proteins; the poisonous residue cake is used for fertilizer. Considered a blood poison (ricin).

Castor oil used medicinally as a purgative. Seeds put in rodent burrows and when eaten often kill rodent pests. Oil used commercially as a lubricant or airplane engines, in increasing the flexibility of leather belts as on motorcycles, as a base for soap, and as an illuminant. Genetic studies valuable.

Smoke Tree *Cotinus coggygria*

Small tree. Height to 40 ft. Trunk diameter to 15 in. Well-branched, usually branching close to ground. Leaves alternate, entire, to 6 in. long and to 2 in. wide, usually blunt at tip and narrowed at base, with blade running down onto petiole.

Found on rocky hillsides or frequently in plantings on lawns and in gardens. Native from Missouri and Oklahoma, south and east to Tennessee and Alabama but widely planted and sometimes established over much of the United States. Some authors place this plant in the genus *Rhus*. One species native of Eurasia.

Flowers small, to $\frac{1}{4}$ in. across, green or sometimes purplish, borne in loose open clusters at tips of branches, clusters being to 8 in. or even more long, densely fuzzy and at a distance having the appearance of smoke. Fruit relatively few but each about $\frac{1}{2}$ in. long.

Wood weighs to 40 lb. per cu. ft., weak, soft, orange-yellow, capable of yielding a rich orange dye. Flowering time April through May. Fruits or fruiting clusters may persist well through summer. Propagated by cuttings or by seeds.

Grown essentially as an ornamental. Dye not used commercially but is popular with amateur naturecraft workers. Common names include yellowwood, chittamwood, American smoke tree. The European species has smaller, fuzzier leaves, more rounded at the base and more leathery in texture.

Staghorn Sumac *Rhus typhina*

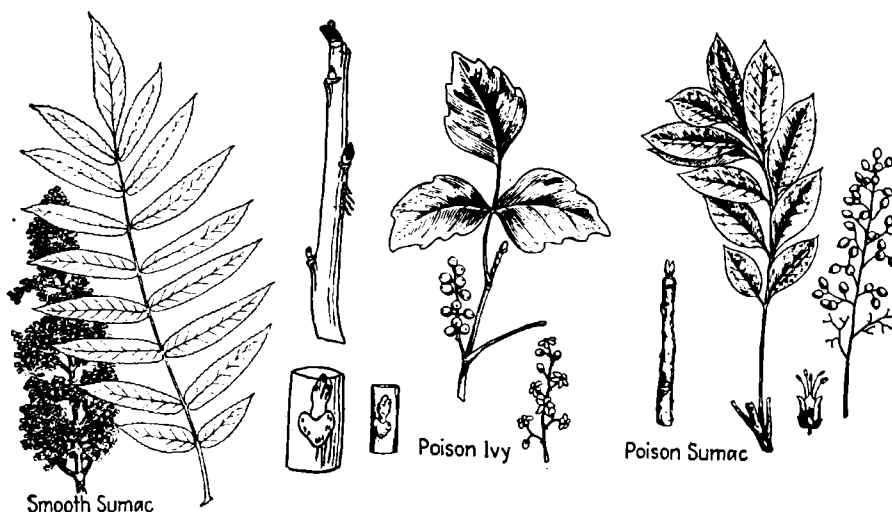
Tree. Height to 40 ft., with trunk diameter to 12 in. Often shrubby. Branched because new year's growth begins from bud back from tip. Twigs coarse, furry, somewhat sticky. Leaves alternate, to 2 ft. long, compound, of 11-31 paired leaflets, each to 5 in. long, dark-green but turn red and yellow in fall.

Native of America. Ranges from Nova Scotia and New Brunswick to Georgia, west to Minnesota, Iowa, and Alabama, being found on dry rocky thin relatively poor soils such as do not support most trees. May form almost pure stands on dry talus slopes and is considered a weed tree by foresters.

Flowers borne in terminal compact clusters appearing in June or July after the leaves; yellowish-green and usually with the staminate in larger, more open clusters on different trees than those bearing the pistillate flowers. Fruits globular, about $\frac{1}{2}$ in. through, turning from green to red and in almost compact mass when mature.

Wood soft, greenish-gold or brown, weighing 27 lb. per cu. ft., burns quickly but leaves little ash. Bark rich in tannin. Pith large and more or less orange. Buds more or less hidden by leaf scars. Sour fruits quench thirst on a hike or make a delicious lemonade if boiled in water and sweetened with sugar.

Wood used in naturecraft for making attractive picture frames needing no finishing with varnish or paint. Plants sometimes grown as ornamentals, particularly a cut-leaf variety, but the clumps soon look bedraggled and lose popularity. However, they do give a quick growth. Fruits eaten by many birds and wild animals.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales. Family Anacardiaceae

Smooth Sumac
Rhus glabra

Tree or shrub. Height to 25 ft. Trunk diameter to 3 in. Branches freely and close to ground to form a flat-topped crown, branching being similar to that of staghorn sumac. Leaves alternate, to 3 ft. long, compound, of 11-31 leaflets, smooth. Twigs coarse and smooth, without fuzz of staghorn.

Native of North America, ranging on poor soils of pastures, hillsides, and waste ground that is usually well-drained, from Maine to British Columbia, south to Florida and Arizona, making it one of the more widely distributed of the woody plants of the country.

Flowers appear in June and July, after leaves, with staminate and pistillate in separate flowers on different trees, staminate being in more open clusters. Fruit a depressed globe, to $\frac{1}{4}$ in. in diameter, covered with close, somewhat sticky fuzz that is sour. Inner part of fruit smooth, orange-brown.

Wood weak and, in general, like that of the staghorn sumac. Not considered a poisonous plant and freely grown as an ornamental particularly in the cut-leaf form. Because of the absence of "fur" on twigs, plant is more likely to be clean than is staghorn sumac which may become filthy in smoky areas.

Landscape architects may consider this one of best plants for quick mass planting in Northeast. Easily propagated by seeds or from suckers arising near base. Cuttings may also be used. Known as shoe-make, vinegar tree, senhalañac, and Pennsylvania sumac. Dried fruits used medicinally as an astringent and as a gargle.

Poison Ivy, Poison Oak
Rhus toxicodendron (radicans)

Woody shrub or vine, the vine climbing by aerial rootlets that cling readily to trees. May have a stem diameter to 4 in. Root system shallow but widely spread. Leaves alternate, compound, of 3 leaflets borne on a long petiole and each to 4 in. long, entire or notched, dark waxy green above and lighter, more fuzzy beneath.

Found in dry fields and rocky exposures as well as on rich croplands or woodlands sometimes high up in trees, but at its best possibly along fence rows and stone walls. Ranges from Nova Scotia to Florida, west to British Columbia and Mexico as well as in Bermuda and the Bahamas. Closely related to poison oak and poison sumac.

Flowers borne on slender open axillary clusters with a calyx of 5 yellowish-green sepals; 5 separate stamens, and a 1-celled ovary that ripens into a white berry-like structure, to $\frac{1}{4}$ in. in diameter, persisting through winter into spring. Stone in the fruit gray and to $\frac{1}{8}$ in. in diameter.

A vicious plant because of its contact poison, which may be carried by smoke. Poison is uroshiol, a yellow, slightly volatile oil present in almost every part of the plant. Poison causes inflammation, spreading blisters, and scabs usually beginning 12-24 hours after contact. It may cause severe suffering and temporary blindness.

Treatment of poison: wash with 5% ferric chloride in 50% alcohol or several times with hot water and laundry soap. Do not use an oily soap. Apply baking powder or Epsom salts, 1-2 tsp. to a cup of water, or extract of *Grindelia* diluted 6-10 in water and applied with a pad. Do not use sugar of lead. If severe, ask assistance of a physician.

Poison Sumac
Rhus vernix

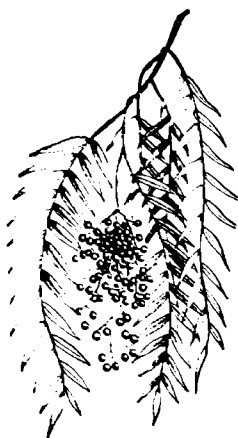
Tree or shrub. Height to 25 ft. Trunk diameter to 6 in. Rather coarse, open plant with gray bark. Leaves alternate, to 15 in. or more long, compound, of 7-13 thin oval to pointed leaflets, each to 4 in. long and to $1\frac{1}{2}$ in. wide. Twigs rather coarse and with small buds. Root system spreading. Whole plant very poisonous.

Limited fortunately to swampy lands but ranges from Maine to Florida, west to Minnesota, Missouri, and Louisiana. About 150 species of the genus and some 400 in the family. 8 species of *Rhus* are considered economically important, including the tree which yields the base of lacquer.

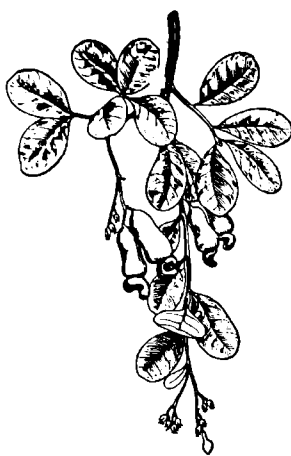
Flowers in loose open clusters borne in axils of leaves, slender, the clusters being to 8 in. long, and individual greenish flowers to $\frac{1}{2}$ in. broad. Fruit gray, globular, with a pulpy covering over a hard center, smooth, to $\frac{1}{4}$ in. in diameter, and persistent through winter.

Wood weighs 27 lb. per cu. ft., soft, yellow-brown. Poisonous properties similar to those of poison ivy but if anything more virulent. Fortunately, the habitat of plant in swamps makes it less likely to be contacted, but brilliant coloring of leaves make it attractive to amateur collectors, often with disastrous results.

Treatment and symptoms of poison of poison sumac and of poison ivy are the same. Poison sumac is also known as thunderwood, poisonwood, swamp dogwood, poison dogwood, poison ash, poison tree, poison elder, and swamp sumac. Most of these names appropriately emphasize the plant's poisonous properties.



Pepper Tree



Cashew



Pistachio

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Sapindales. Family Anacardiaceae

California Pepper Tree *Shorea molle*

Tree. To over 20 ft. high, with conspicuously pendulous, slender branches giving top a rounded appearance. Leaves alternate, smooth, to over 1 ft. long, compound, of 30 or more smaller leaflets, each to 2 in. long and $\frac{1}{2}$ in. wide, evergreen. Bark scaly.

Native of tropical regions of America, with this species from Peru but about 7 other species known from tropical America. Possibly most commonly grown ornamental tree in southern and central California. Known as mastic tree for its resemblance to the real mastic tree.

Flowers borne in much-branching open clusters, yellowish-white, frequently old in flower shops for their decorative beauty. Fruits rose-colored, almost spherical, to nearly $\frac{1}{2}$ in. in diameter and fully as attractive as the flowers. Fruits of related Christmas berry tree are smaller and bright red.

In California, this tree is at its best in warmer parts of state. More satisfactory as an ornamental than as a shade or street tree because its branches frequently extend almost if not quite to the ground. Staminate and pistillate flowers on separate trees, so all trees will not bear fruits.

This tree should be familiar to all notion-picture fans since its artistic beauty makes it a tree favored by producers even if setting is in New England or Canada where the trees never grow. It, eucalyptus, and some palms make characteristic California landscape.

Cashew *Anacardium occidentale*

Tree. Height to 40 ft. Juice milky, but hardening into a gum when exposed to air, much like gum arabic. Leaves alternate, oval, rounded, sometimes slightly notched at tip, to 8 in. long and to 4 in. wide, evergreen but very susceptible to frosts, borne on short petioles.

Native of tropical America particularly in West Indies but may survive climatic conditions in southern Florida. Widely cultivated in tropical regions of world. Grown in greenhouses in part as a curiosity. 8 species native of American tropics but only this one is cultivated.

Flowers brownish-green, in loose, open clusters, fragrant, rose-tinted, with staminate flowers on same plant that bears both stamens and pistils in the same flower. Stamens to 10. Petals, 5. Fruit to 3 in. long, white, yellow, or red, sweetish-sour, edible cashew apple that is crowned by the 1-in. curled nut.

Nut enclosed in 2-layer, leathery, oily, acrid covering. Oil (cardol) driven from cashew apple by heat is highly irritant to skin and eyes and may cause dermatitis. Roasted nuts delicious, may yield, if crushed, a valuable cooking oil equal in some respects to olive oil. Trees grown from cuttings of mature, leaf-bearing wood.

United States imports cashews largely from British Indies. A fermented, distilled beverage (kaju) is made from cashew apples in Brazil and West Indies, sometimes bottled. Gum from juice is used in varnish to resist termites and other insects. Ripe fruits are eaten raw in tropics. Vast Brazilian stands are untouched commercially.

Pistachio *Pistacia vera*

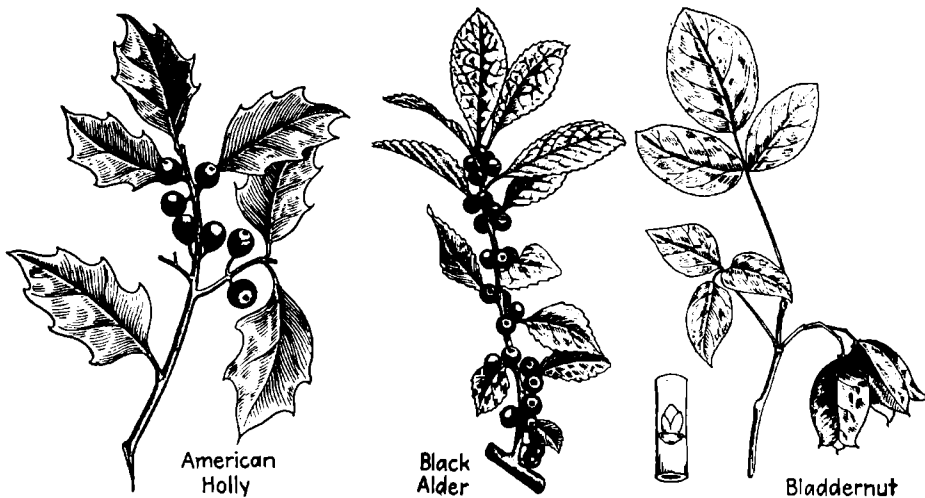
Tree. Height to 40 ft., with spreading branches. Leaves at first fuzzy then smooth, alternate, compound, to 7-15 stemless leaflets, borne most abundantly and with greatest leaflet number on young shoots. One cultivated variety has only 3-5 leaflets. Bark of twigs brown.

Native of Mediterranean and western Asiatic regions, with a close relative *P. texana* found from Texas into northern Mexico. 8-9 species, most of which are found in warmer regions from China through Mediterranean area.

Flowers brownish-green, in loose open clusters, with staminate and pistillate flowers on separate trees, without petals. The staminate, with 5-cleft calyx and 5 stamens; pistillate, with 3-4-cleft calyx. Fruit a wrinkled, reddish, 1-in., double-shelled nut-like structure, with outer shell red and inner brittle.

Kernel has a pale green or creamy yellow rich sweet oil that has exceptional flavoring possibilities. Related species of importance include the Cyprus turpentine tree *P. terebinthus* and the mastic tree *P. lentiscus*, which produces a gum useful in varnishes and in a form of chewing gum.

Pistachios are not cultivated in United States, our imported products coming mostly from the British Indies, which yield about $\frac{3}{4}$ of our needs, while $\frac{1}{4}$ come from Syria and the remainder from Iran, Italy, and elsewhere. Reported to have been sent by Jacob into Egypt and has been grown for centuries in Palestine.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales

Family Aquifoliaceae

Family Staphyleaceae

American Holly
Ilex opaca

Tree. Height to 100 ft. Trunk to 4 ft. in diameter. Branches short and slender. New branchlets stout and at first covered with brown fuzz; after first season smooth. Bark gray, rough, $\frac{1}{2}$ in. thick. Buds sharp, to $\frac{1}{4}$ in. long. Leaves evergreen, to 4 in. long and $1\frac{1}{2}$ in. wide, dark-green, leathery, with spine-tipped scallops or rarely entire.

In moist woodlands from Massachusetts to Florida, west through Pennsylvania to Indiana, Missouri, and Texas, being found in North Carolina at an elevation of 3,000 ft. Probably at its largest and best in the rich bottom lands of Louisiana. Related English holly is planted rather widely where suitable. Some large trees are found in Pacific Northwest.

Staminate flowers found in clusters to 1 in. long and on different trees from those bearing the pistillate. Pistillate flowers more scattered, usually only 1-2 in a cluster though a number of clusters may be close together. Fruit fleshy, with stone center, sometimes to nearly $\frac{1}{2}$ in. through, spherical, red or rarely yellow.

Wood hard, white, uniform, weighing to 36 lb. per cu. ft., tough but weak, turns brown with exposure or age and used extensively in wood turning, cabinetwork, interior finishing, and otherwise. Tree highly resistant to salt spray so is suitable for growing for ornament along the coast. A relatively slow grower.

Tree most popular for the fruits, borne of course only on pistillate tree, the fruits being used mostly for Christmas decoration with the leaves. So popular is this use that unless trees are protected they are almost certain to be despoiled. Flowers appear in the Northeast in May and June. Plant propagated by cuttings. Berries reported to be poisonous.

Black Alder, Winterberry
Ilex verticillata

Bush or shrub. Height to 25 ft. Twigs brown and smooth or slightly fuzzy. Old bark darker. Leaves to 3 in. long and to 1 in. wide, sharply pointed at tip, with shallow-toothed margins and relatively short petioles, thick, leathery, smooth above and slightly fuzzy beneath, not evergreen, turning black in fall.

Found in swamps, low grounds, and other wet places. From Connecticut to Florida, west to Wisconsin and Missouri, with varieties extending range north to Nova Scotia; related species extend range south and west. Over 250 species of *Ilex*, mostly in America but also in Asia, Australia, and Africa; 5 in United States.

Flowers: staminate, in clusters of to 10 borne on short stems in leaf axils; pistillate, in clusters of 1-3 borne close to stem at bases of leaves, almost as though they formed a ring around the stem. Fruit bright red, to $\frac{1}{4}$ in. through, containing smooth nutlets.

While leaves of related *Ilex vomitoria*, cassioberry, and *I. glabra*, gallberry, yield a fair substitute for tea, in part because of reported caffeine in leaves, this substance is apparently lacking in leaves of black alder. Nevertheless it is suggested as a tea substitute. Berries reported to be poisonous.

Plant popular as a winter ornamental, and fruit-bearing twigs find a too-ready market in florists shops; is also cultivated for planting as an ornamental but its moisture requirements limit its usefulness in this respect. Known as false alder, striped alder, white alder, and black alder.

Bladdernut
Staphylea trifolia

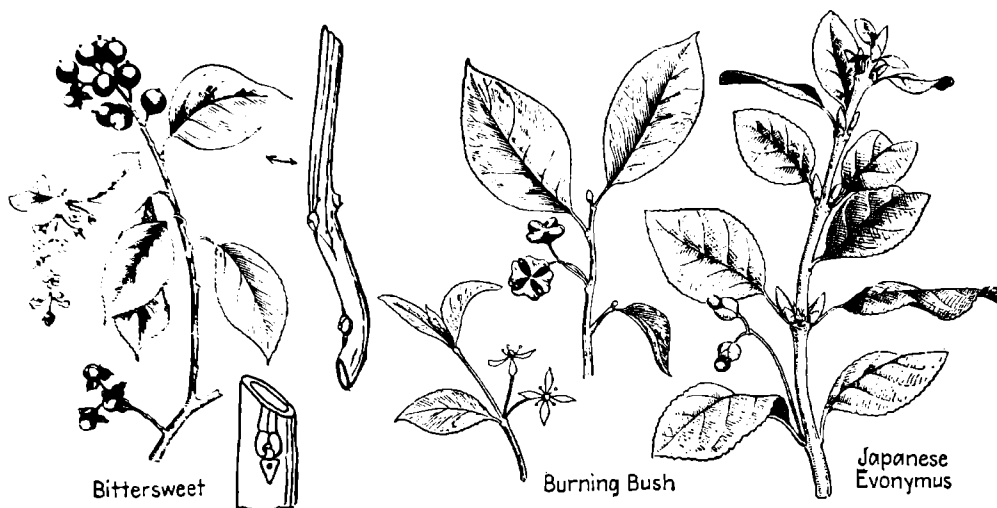
Shrub or small tree. Height to 15 ft. Branches profusely. Trunk to 6 in. in diameter. Bark smooth and striped. Leaves opposite, of 3 leaflets, each to $2\frac{1}{2}$ in. long, pointed-tipped; lateral leaflets without stalks but whole leaf rather long-petioled; smooth when mature but partly fuzzy when young.

Found in wet woodlands and brushy territory from Quebec to South Carolina west to Minnesota, Missouri, and Kansas. Some 11 species known, all native of temperate climates in Northern Hemisphere; and 1, *S. bolanderi*, found native in California. 22 species in the family, giving group a wide distribution. Chiefly Asiatic.

Flowers in rather loose, semihanging clusters, borne from between a pair of leaves; flower stems, slightly longer than flowers themselves. Fruit spectacularly inflated into a bladder of 3 or rarely 4 parts, each of which contains a globular seed, the bladder being to 2 in. long.

Will grow in almost any soil but at best in rich moist shaded area. Propagated by using seeds, cuttings, or by layering the growing branches. Cuttings forced in greenhouses so that they form dependable root systems. Pinkish flowers appear in May; conspicuous nodding fruits, in fall and winter.

Grown primarily as an ornamental for its clean pale green foliage, its intriguing, bladder-like fruits, and rather attractive flowers. Hardy in northern United States but not so rugged as some of the more commonly used ornamentals.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales. Family Celastraceae

Bittersweet

Celastrus scandens

Climbing and twining vine with a length of 30 ft. or more. Twigs yellowish-green to brown, frequently winter-killing at the tips. Leaves alternate, more or less 2-ranked, to 4 in. long and to 2 in. wide, smooth on both sides, with petioles to $\frac{3}{4}$ in. long and margins obscurely uneven or with shallow curved teeth, pointed at tip.

Found in rich soil, along roadsides, or in woods from Quebec to North Carolina, west to Manitoba, Kansas, and New Mexico, being found at high elevations in southern part of range. While there are some 30 species of the genus, only this one is in North America though a few are found in tropical America.

Flowers, staminate may be on one plant; other plants may bear both stamens and pistils; greenish, relatively inconspicuous, in clusters that are to 4 in. long, at the ends of branchlets. Petals longer than lobes of calyx but flowers very small. Fruit a yellow capsule, to $\frac{1}{2}$ in. through, that bursts to expose a showy, attractive, red center.

Conspicuous in fall and winter and even into spring because of red-centered fruits on fertile plants. Propagation by seeds, or more simply by cuttings that root readily. Such cuttings should be from plants that bear fruits if plants are grown for ornamental purposes. Horses have been poisoned by eating leaves. Fruits have the poison euonymin.

Some forms grown for ornament have variegated foliage. Fruits collected on twigs in fall, made into bunches and find a ready sale in flower shops for semipermanent winter bouquets indoors or for a substitute for holly at Christmas time. Twining nature of plant may cause it to kill useful forest trees by strangulation.

Burning Bush

Euonymus atropurpureus

Tree or shrub. Height to 25 ft. Twigs greenish or green-blue, conspicuously but bluntly 4-angled, often conspicuously long and straight. Leaves opposite, to 5 in. long and to $2\frac{1}{2}$ in. wide, pointed at tip, sparingly fuzzy beneath, thin, with $\frac{1}{2}$ in. petioles and margins, with shallowly curved teeth that are very small.

Grown as an ornamental but native of area from Ontario to Florida, west to Montana, Oklahoma, and Nebraska. Persists in spite of abandonment and is relatively common about abandoned homesites in some parts of its range. Some 120 species native of North Temperate Zone, of which 2 are California species.

Flowers purple, to $\frac{1}{2}$ in. across, in clusters the parts of which branch repeatedly in 3's. Petals, usually 4. Fruit a smooth, deeply 3-lobed or parted capsule that is $\frac{1}{2}$ in. or more through and bursts to expose a red center, giving the plant its name.

Hardy. Seems to do well in variety of soils with propagation commonly being by seeds or by cuttings. Seeds collected in fall, stratified in sand, and sown in spring. Wood cuttings made in fall from matured wood, rooted under glass in winter, planted in spring. Wood white, 41 lb. per cu. ft.

An attractive and popular ornamental. Bears the name arrowwood because it is assumed Indians used straight branches as arrow shafts. These were sometimes stimulated by cutting the tree or shrub back or burning it and then using the vigorous straight suckers that came on afterwards.

Japanese Euonymus

Euonymus fortunei

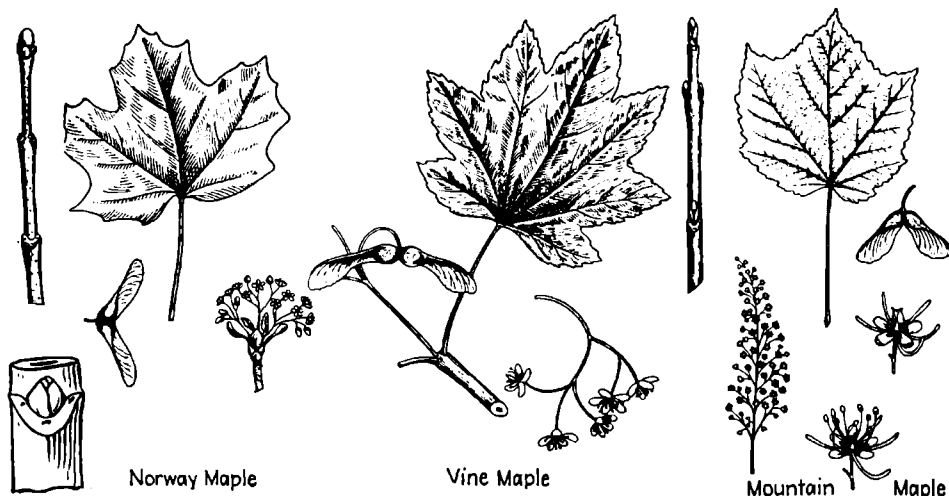
Low shrub or more commonly a climbing, clinging vine that fastens itself to walls of buildings and may reach to a height of 20 ft. or more, providing a green cover for otherwise bare walls. Branches round, warty. Leaves green, rounded at base, white-veined, to 2 in. long, evergreen.

Native of Japan but widely grown as a cover and ornamental through temperate parts of the Northern Hemisphere. A large number of varieties based upon size and color of leaves, general growth habit, and other factors have been developed by horticulturalists. Better than a dozen species are considered as stock ornamental woody plants.

Flowers pale greenish-white, in clusters generally of a few, the usual number of parts 4; borne on slender stems making a rather open cluster. Fruit smooth, pink, globular capsule that matures usually in October. Flowering time June or July.

Propagation, like that of most woody plants of this type, usually by cuttings of mature wood rooted through winter in greenhouses and planted following spring. Because of evergreen leaves and climbing habit, this is a popular ornamental on school buildings.

Although botanists spell the name *Euonymus*, the popular form of the name is *Euonymus*.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales. Family Aceraceae

Norway Maple
Acer platanoides

Tree. Height to 100 ft. Head round and well-spread. Bark finely checkered, ridged, relatively close, dark, uniform. Leaves opposite, to 5 in. long and of equal width, with 5 lobes much like in sugar maple but with a slightly milky juice in petiole; underside somewhat shining green and smooth.

Native of Europe and western Asia but widely planted as a superior ornamental in America where it frequently excels sugar maple as a street tree in popularity. A variety *schwedleri* has bright red leaves when young but these change to dark-green with maturity. Horticulturalists have developed many interesting forms.

Flowers yellowish-green, in erect, smooth, spherical, rather open clusters, appearing at about the same time as the leaves do or a little before. Sepals and petals distinct. Fruits paired, equal, maturing in September, with wings widely spread. 40-70% germination.

Many garden forms are based on shape and color of leaves, as suggested by names *albovariegatum* (white blotched) and *rubrum* (red) as well as *dissectum*, *globosum*, and *laciniatum* suggesting differences in shape. *A. platanoides* *aureomarginatum* suggests a unique color and shape form.

Leaves turn pale yellow in fall rather than red as do sugar maples. Attractive fruits, rather pretty flower clusters, smooth even dark bark, and general cleanness of this species entitle it to the popularity it enjoys as a shade tree. Has few insect and fungous enemies and is tolerant of city conditions.

Vine Maple
Acer circinatum

Tree. Height 30 ft. with a trunk to 1 ft. through, or just as commonly a prostrate vine-like plant that branches freely in many directions. Bark thin, smooth, red-brown, with many shallow fissures. Leaves rather circular, but with 7-9 pointed lobes, with conspicuous veins, rose or red in spring and fall.

Found along stream banks from British Columbia south through western Washington and Oregon to the Sacramento River country in California. In Oregon and northeastern California, found up to 4,000-ft. elevation, but at its best in rich lowlands.

Flowers appear with leaves, in loose open clusters of to 20 flowers that hang, with staminate and pistillate flowers in same cluster. Sepals red, purple, and much longer than the broad greenish-white petals. Fruit with thin wings, double, spread at right angles, red or rose, to 1½ in. long, ripe in fall.

Wood heavy, close-grained, hard, not strong, light brown to white with much lighter sapwood. Winter buds blunt, to ¼ in. long, with bright red scales. Hardy in East as an ornamental, north into Massachusetts; easily transplanted or grown from cutting of the vine-like plant.

Popular as an ornamental because of red flowers, rose-colored fruits, and attractively shaped leaves that are delicate light green in summer and a brilliant orange or scarlet in fall. Wood used as fuel, as tool handles, and because of twisted shapes is popular in making fishing-net bows.

Mountain Maple
Acer spicatum

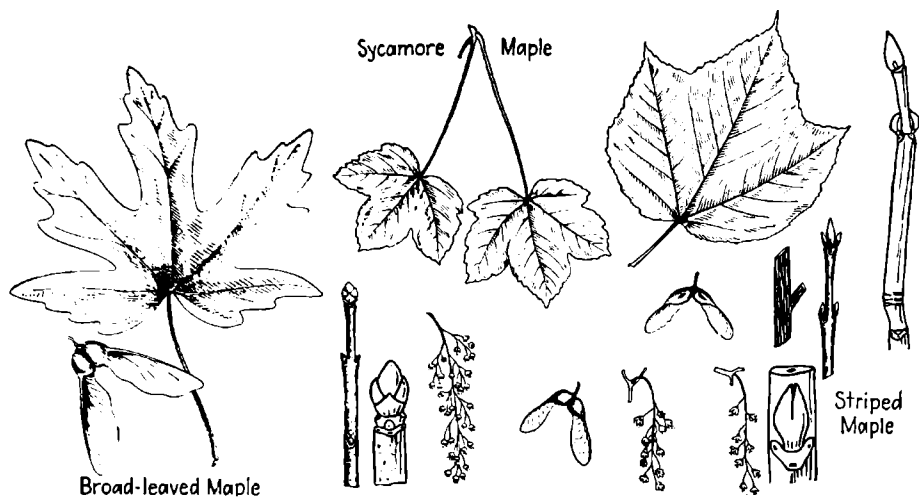
Bushy tree. Height to 35 ft. Trunk diameter to 8 in. Bark green and not striped. Often appears merely as a weak bent shrub in a thicker formation. Leaves opposite, to 5 in. long, rather coarsely notched along margins but with 3 distinct pointed lobes, conspicuous veins, and thin texture.

Found in damp rocky woodlands or on sides of gorges, apparently surviving in shade or sun but doing best where neither is too strong. Ranges from Newfoundland and Labrador to Georgia, west to Manitoba, Minnesota, Iowa, and Tennessee. Found at 5,000-ft. elevation in North Carolina. In southern part of range, is found in mountain areas.

Flowers appear after leaves are fully grown, greenish-yellow, borne in narrow, erect, long-stalked, terminal clusters with fertile or pistil-bearing flowers near base of cluster. Stamens, 7-8, free. Petals usually 5, pointed, narrow, longer than sepals. Fruit red, compressed, leathery, drooping, each to ½ in. long.

Wood weighs to 33 lb. per cu. ft., soft, coarse-grained, relatively weak, light brown with red tinge and with lighter sapwood. Winter buds bright red, slender, pointed, becoming to 1 in. long at times. This species can survive strong sunlight better than can the striped maple.

Of little economic importance though fruits may provide some bird food. Wood makes fair campfire fuel and is sometimes cut for a regular fuel supply. Tree often grown as an ornamental in gardens and parks where conditions are suitable.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales. Family Aceraceae

Broad-leaved or Oregon Maple
Acer macrophyllum

Tree. Height to 100 ft., with tall straight trunk with a diameter of to 3 ft. and branches that tend to droop or hang at the ends. Twigs pale green at first but become red or bright green by winter. Leaves opposite, deeply 5 or 3-lobed, to 1 ft. long, with a petiole to 1 ft. long, dark-green and shining above.

Native of western North America but not hardy in the northern parts above 55° latitude. Ranges from British Columbia to Oregon, and in the mountains south to the border, being between the 2,000- and 3,000-ft. level in Sierra Nevadas and rarely above 3,000 ft. farther south. At its best in rich soils of southern Oregon.

Flowers appear after leaves, bright yellow, fragrant, to $\frac{3}{4}$ in. long, on slender drooping stems nearly 1 in. long. Sepals, petal-like. Staminate and pistillate flowers separate. Fruit grown by July, mature by late fall, double, with wings to $1\frac{1}{2}$ in. long and to $\frac{1}{2}$ in. wide. Seeds $\frac{3}{4}$ in. long, brown.

Wood not strong, light brown, soft, close-grained, red-tinged, with thick, nearly white sapwood, extending through 60-80 annual rings in larger trees. Grown primarily more as a shade tree, in part because of its beautiful large leaves.

Wood used for fuel, for cheap furniture, flooring, and general interior finishing, also for tool handles such as broom handles or sometimes even for cheap ax handles. It is possibly the most valuable wood produced by any of the deciduous trees of the western part of the country.

Sycamore Maple
Acer pseudo-platanus

Tree. Height to 70 ft. Head large and spreading. Bark rather thick, gray, well-furrowed longitudinally. Twigs rather coarse, straight, large-budded. Leaves opposite, 5-lobed, to 6 in. long and of similar width; margins with coarsely curved teeth; veins rather conspicuous, dark-green above and light beneath.

Native of Europe and western Asia but planted extensively in the temperate parts of America. Does well in exposed positions where its form may become broad-crowned with rather divergent branches for a maple.

Flowers appear with or after the leaves, in rather long hanging loose clusters, with rather long hairy stamens. Fruit paired, smooth, with widely spread wings, shed in autumn, larger than in sugar maple and somewhat smaller than in larger fruited silver maples.

Horticultural varieties with suggestive names include *bicolor* (yellow and white), *tricolor* (purple, yellow, and green), *quadricolor* (green, purple, white, and yellow), *albo-variegatum* (white-spotted), *purpurascens* (purple), *erythrocarpum* (red-fruited), *nervosum* (conspicuously veined), and *villosum* (fuzzy beneath).

Because of irregular shape and coarser bark and leaves, this species lacks the popularity as a shade tree enjoyed by other species of a generally similar nature. In its native Europe, it is justly considered an important hardwood, taking the place there of our sugar maple.

Striped Maple, Moosewood
Acer pennsylvanicum

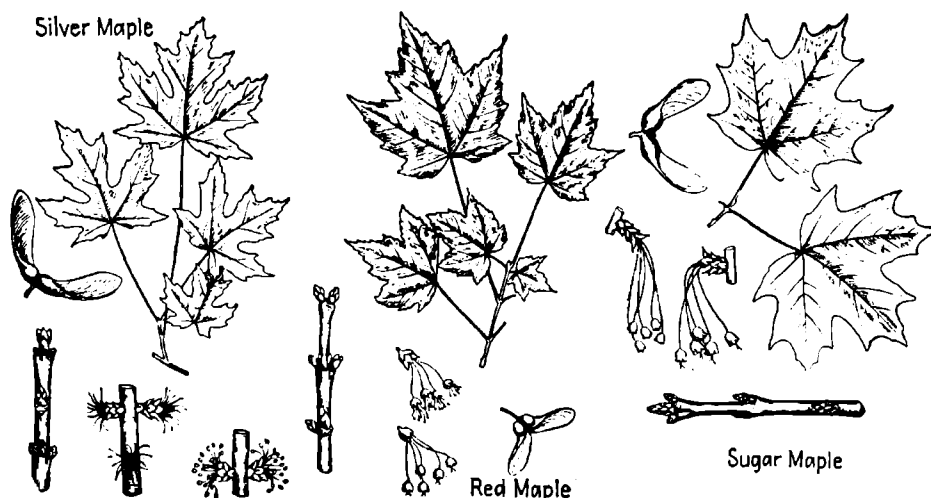
Tree. To 30 ft. high. Usually slender, straight, and beautiful. Trunk to 10 in. through. Bark smooth and attractively streaked vertically with dark-green and gray or white. Roots shallow. Twigs slender, weak, usually straight, red and green, with 2-scaled buds. Leaves opposite, like track of goose's foot, rounded at base, finely notched along margin.

Common in mixed woodland borders, or near streams but always in the shade of other trees. From Nova Scotia to Minnesota, south to Georgia in country that provides typical cover for moose and deer. Not found among giant trees of other species nor in pure stands of its own kind. Largest in Big Smoky Mountains.

Flowers borne in May and June, with staminate and pistillate flowers separate but on the same plant, in loose drooping clusters. Pollination probably by insects. Fruits paired samaras that may remain on tree through first winter, being finally broken free and carried by wind. Seedlings develop year following the flowering. Fruit red in July, $\frac{1}{2}$ in. long.

Wood of little importance commercially and generally weak; weighing 33 lb. per cu. ft.; soft, pale, close-grained. Leaves turn to orange or scarlet in fall. Common name goosefoot maple refers to resemblance of leaves to shape of goose's foot.

Since it cannot survive strong light, it is of value as an ornamental mixed with other trees. Bark, fruits, leaves, and flowers make it popular with man. Twigs furnish a favored browse for deer and moose and give plant the name moosewood.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales. Family Aceraceae

Silver Maple
Acer saccharinum

Tree. Height to 120 ft., with trunk diameter to 5 ft. Main trunk usually short, dividing at least by 10-15 ft. and eventually with drooping or pendulous slender twigs. Leaves opposite, deeply 5-lobed, with narrow segments that are often narrowest at base, dark-green above, silvery beneath, to 6 in. long.

Native of America. Ranges from New Brunswick to Florida, west to South Dakota, Kansas, Oklahoma, and Louisiana but planted frequently outside its natural range and sometimes established as an escape. Favors more moist situations than does red maple and is found on swamp borders and along streams in wild country.

Flowers appear early in season, long before leaves, and mature their fruits early. Staminate and pistillate clusters separated either on one tree or on different trees. Some flowers may bear both stamens and pistils. Fruits smooth, unequal, double, winged, with wings to 2 in. long and rather widely spread.

Wood is "soft maple," weighs to 32 lb. per cu. ft., light-colored, hard, strong but weaker than sugar maple. Sap sweet, used somewhat for maple sugar but amount flowing is negligible and sugar content much less than that of sugar maple. Chief value is in the ornamental qualities of the tree.

Varieties include *laciniata* (cut-leaved), *pendula* (drooping-twigged), *heterophyllum* (unequally divided), *tripartitum* (3-parted leaves), *albovariegatum* (white or pink-spotted), *crispum* (crimped); and *lutescens* (yellow). Known also as soft, river, creek, swamp maple. Seeds 21,000 per lb., 25-50% germination.

Red Maple
Acer rubrum

Tree. Height to 120 ft. Trunk diameter to 4½ ft. Bark gray, closer than in silver maple but possibly rougher than in sugar maple. Makes compact, rounded head. Leaves opposite, 3-5-lobed, with irregularly cut margins, bright green above, pale green or whitish beneath, to 6 in. long and nearly as wide.

Native of North America. Found in swamps and low grounds, associated with black ash, red gum, pepperidge, and cypress or often on higher ground. Ranges from Newfoundland to Florida, west to Manitoba, Nebraska, Oklahoma, and Texas. Found at 4,000-ft. elevation in Virginia. A number of varieties recognized.

Flowers appear much ahead of leaves, giving a bright yellow or red cast to tree; axillary. Petals, narrow. Stamens, 3-6. Staminate and pistillate flowers in separate clusters on same or on different trees, with stamens often in the pistillate flowers. Fruits double, winged, smooth, incurved, each to 1 in. long, with wing to ½ in. wide.

Wood weighs 38 lb. per cu. ft., light reddish-brown, medium hard, medium heavy, not strong, close-grained, light brown with rose cast, with thick pale sapwood, sold in trade as "soft maple" with silver maple; rather good campfire fuel. Closely related to Carolina maple. Winter twigs lack odor of silver maple when crushed.

Makes a fair ornamental or street tree but best planted at edge of a forest for color effect in spring. Wood used in cheap furniture, flooring, woodenware, crates, and wood turning. Bears common names of swamp maple, white maple, soft maple, shoe-peg maple, and others. Seeds number 18,400 per lb. and have 25-60% germination.

Sugar Maple
Acer saccharum

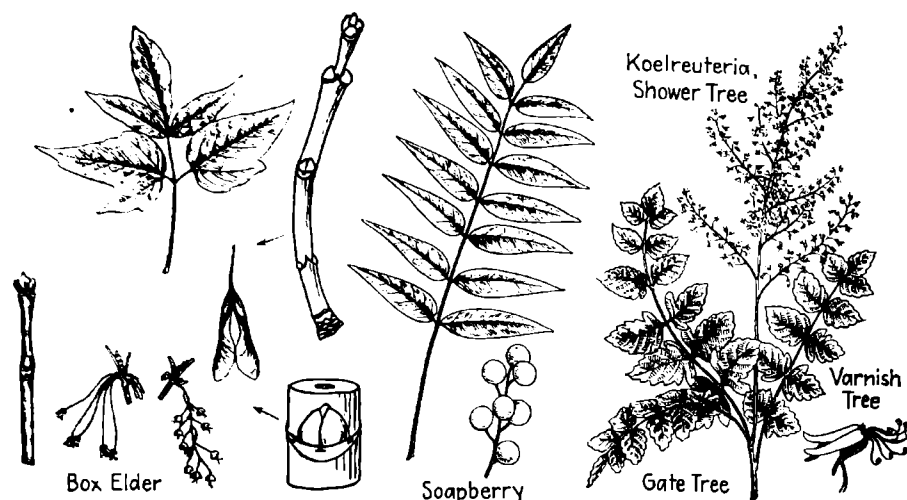
Tree to 135 ft. high. Egg-shaped to cylindrical. Trunk to 5 ft. in diameter. Bark relatively close but with vertical ridges, irregular in shape and depth, grayish. Roots shallow. Twigs russet, straight, slender, with opposite, pointed, many-scaled buds. Leaves long-stalked, thin, with blade wider than long, somewhat 5-lobed, red or yellow in autumn.

Common on rocky highlands from southern Newfoundland, west to southeastern Manitoba, south through eastern North Dakota and Iowa to northeastern Texas, east through northern Gulf States to Piedmont in Virginia and north. Grows frequently in relatively pure stands but may be found mixed with beech, birch, and ash with large trees of these kinds represented.

Flowers appear with leaves, small, yellow, in groups near ends of twigs, borne on slender drooping stalks, with both stamens and pistils in same flowers. No petals. Fruits, paired winged samaras with 1-in. wings, about parallel to each other or only slightly spreading. Mature in fall. Seedlings develop the following spring, with 2 narrow seed leaves showing first. May live 300 years.

Wood heavy, hard, uniform, close-grained, light-colored, easily polished, durable, with thin sapwood, sometimes with curly grain yielding bird's-eye maple. Seeds 7,000 per lb., with 30-50% germination, planted at once in fall at depth of ½ in. In 1 year reach to 9 in. Tree with 15-in. trunk has ½ acre leaf surface that needs 100 tons of water a season.

Wood used in furniture, flooring, interior finish, pulley blocks, broom and tool handles, and as fuel. Wood ashes high in potash and used by pioneers in making soap. Sap contains 2½% sugar and is boiled to make maple sirup and maple sugar. Average tree may yield ½ gal. of sirup or 4 lb. of sugar, though large trees in good season may yield 15 times this amount. 40 gal. sap equals 1 gal. sirup or 8 lb. sugar.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales

Family Aceraceae

Box Elder, Ash-leaved Maple
Acer negundo

Tree. Height to 75 ft. Trunk diameter to 4 ft. Trunk short, usually more or less deformed. Crown broad and rounded. Stump sprouts very readily. Leaves opposite, to 15 in. long, compound, of 3-9 leaflets, each to 5 in. long and to 3 in. wide. Sometimes doubly compound in part. Leaves smooth.

Usually favors wet areas along waterways but may be planted and will thrive in drier situations. Ranges from Maine to Florida, west to Manitoba, western Minnesota, Kansas, Texas, and Mexico though it is planted extensively outside this range. Closely related to western ash-leaved maple *A. interior* of Rocky Mountains.

Flowers appear in April and May, with or before leaves, on growth of preceding season, yellow-green with tasseled staminate on one tree and pistillate on another, the latter being borne in narrow drooping clusters that elongate in fruit. Fruit smooth, paired, winged structures, 1-seeded, to 2 in. long, persisting.

Wood weighs 27 lb. per cu. ft., light, weak, soft, white, close-grained but capable of being worked easily into structures that do not require any considerable strain. Trees frequently winterkill and assume an unkempt appearance but they grow rapidly and so have been popular as shade trees in new real-estate developments.

Inferior shade tree because of relatively short life and considerable trash forming beneath. Staminate trees drop less trash than do the pistillate. Wood used somewhat as fuel, in making crates, cheap furniture, and coopering. Some horticultural varieties have been developed.

Soapberry
Sapindus drummondii

Tree. Height to 50 ft. Trunk diameter to 2 ft. Old bark with well-fissured surface. Leaves to 1½ ft. long, compound, of 7-19 leaflets, each entire-pointed particularly at tip and to 4 in. long; usually slightly curved because one side is shorter than the other.

Locally common on hillsides or river valleys from Missouri to Kansas, south through Louisiana, Texas, and Arizona into Mexico. The related soapberry of commerce *S. saponaria* can be grown successfully in southern Florida and in southern California. Its leaves are evergreen, while this tree has deciduous leaves.

Flowers borne in open clusters that are to 8 in. long with the individual flowers white and to ½ in. across, with many in a single cluster while the stems are fuzzy and many-angled. Sepals much shorter than petals, which are rounded at tip. Fruit is ripe in fall, a yellow globe ½ in. through, turning black.

Wood weighs 59 lb. per cu. ft., heavy, hard, close-grained, light brown with a yellow tinge, with still lighter sapwood that is about 30 annual rings thick. Wood splits easily into thin strips, each representing an annual growth in thickness. Fruit soapy. Plant does well on moist clay or on dry limestone soils.

Wood used rather extensively in making baskets for harvesting cotton and for frames for packsaddles. Beries used as a source of soap, though handling them may cause a dermatitis because of contained saponins. The cultivated soapberry flowers in fall and bears fruits in spring.

Family Sapindaceae

Gate, Shower, Varnish Tree
Koeleruteria paniculata

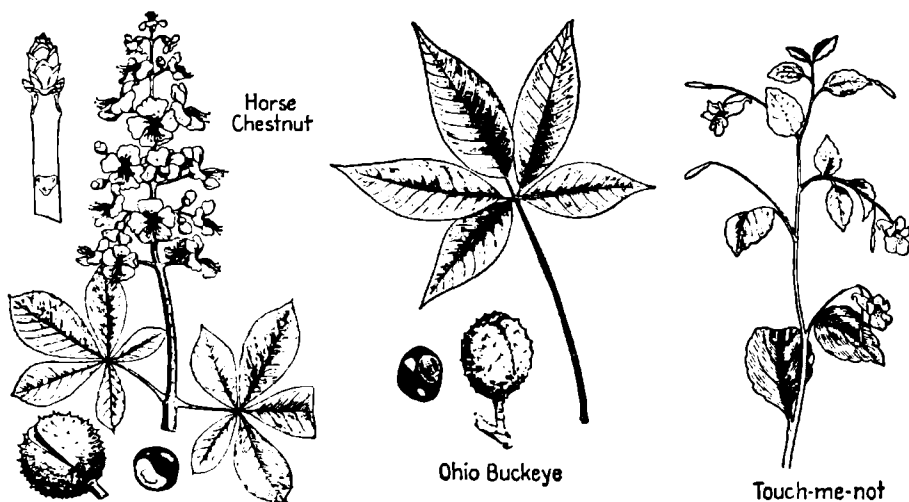
Tree to 30 ft. high. Bark finely furrowed. Head round and rather compact. Twigs coarse, brown-barked. Leaves alternate, once or twice compound, to 18 in. long, of 7-15 leaflets, each to 3½ in. long, coarsely veined, dark-green above, coarsely indented along margin, smooth, attractive.

Native of China, Korea, and Japan. Cultivated in United States particularly from Kansas to south and in region of southern Indiana, though it survives well in New York and to the west where there are hot dry winds. Related to soapberry *Sapindus saponaria*, there being about 1,000 species in family, mostly trees.

Flowers about ½ in. long, in many-flowered clusters, forming a loose open cluster that hangs downward, cluster being to 1½ ft. long while individual flowers are about ½ in. long. Flowers yellow, appear in July and August or sometimes earlier. Fruit a 2-in. papery attractive inflated bladder.

Tree may winterkill in northern New York, but in southern Indiana it may grow uninjured to mature size. Grown as a street tree for its most attractive flowers and fruits and because of its general beauty. Common names varnish tree and China tree properly belong to other plants.

Known in some places as "gate tree" because when New Harmony settlement was made in southern Indiana, Thomas Say and others set trees at gates. This has become a custom so that many campuses of the country have these trees growing at the gates.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Sapindales

Family Sapindaceae

Horse Chestnut

Aesculus hippocastanum

Tree to 75 ft. high. Trunk to 3 ft. in diameter, frequently continuous to top of tree but usually branching. General shape conical, lower branches drooping but turning up at tips. Bark dull brown with irregular scale plates. Twigs coarse, with large brown to black sticky buds. Leaves opposite, palmately compound, of 7 leaflets, each to 10 in. long.

Originally native of Greece but planted widely and established in many places where it has been introduced as a shade and ornamental tree. Closely related to Ohio buckeye and to red horse chestnut of Pacific Northwest. Also a dwarf shrubby form *A. parviflora* frequently used in formal plantings.

Flowers showy white with a red tinge, to nearly 1 in. across, in open panicles to 1 ft. long. Petals, 5. Flowers borne at ends of twigs causing twigs to branch the next year. Fruit a weak short-spined bur, green, containing a few large brown large-scarred seeds having a high percentage of germination.

Wood light, soft, close-grained, whitish or yellowish, not strong. Seeds mature in October or November; must be buried and frozen before they germinate. In spring, planted 1 in. deep and 5-8 in. apart, reaching a height of to 18 in. as seedlings first year. A severe blight of leaves. Winterkilling often deforms or injures trees.

Wood used by wood turners and wood carvers because of fine uniform quality and because it can be cut easily. Seeds appear to be edible but are bitter and are considered by some to be poisonous. A flour paste made from seeds is reported to be poisonous to insects. Alcohol has been extracted from seeds. Great popularity is as a shade tree.

Ohio Buckeye

Aesculus glabra

Tree. Height to 70 ft. Trunk diameter to 2 ft. Branches small and spreading. Twigs rather coarse. Winter buds not sticky as in horse chestnut, to $\frac{3}{4}$ in. long and more pointed. Leaves opposite, compound, of 5-7 leaflets, each to 6 in. long and arranged like the fingers on the hand, mostly smooth and with a petiole to 6 in. long.

Found along river bottoms and stream banks from southern Pennsylvania to northern Alabama west to Iowa, Nebraska, and Missouri. Ohio buckeye has many horticultural and other varieties and is cultivated in eastern United States and Europe. Hardy into northern Massachusetts. Related California buckeye and others extend range considerably.

Flowers in loose, open, terminal clusters that are to 6 in. long while the individual flowers are yellow, to $1\frac{1}{2}$ in. long or twice the length of their supporting stems; appear in April or May. Stamens conspicuously incurved. Fruit to $1\frac{1}{2}$ in. in diameter; prickly when young but smoother at maturity, freeing large brown seeds.

Wood weighs to 28 lb. per cu. ft., white, soft, not strong, close-grained, often with brown blemishes, decays easily unless kept dry, with thin dark sapwood that is 10-12 annual layers thick. Pollination probably by bees. There are shrubby forms, large-flowered forms, and others well-known to horticulturalists.

Wood used in making paper pulp, artificial limbs, and woodenware: sometimes sawed into rather inferior lumber. An extract of the bark has been used as an irritant for the cerebrospinal system. Probably the most universal use, however, is as an ornamental tree or shrub. Unofficial state tree of Ohio, the Buckeye State.

Family Balsaminaceae

Touch-me-not, Jewelweed

Impatiens pallida

Herb. Height rarely to 6 ft. Annual, smooth, with semitranslucent stems showing the bundles within, hollow, semisucculent, and showing swellings at the joints. Leaves thin, pale green, alternate, smooth above and below, semisucculent, blunt, to $3\frac{1}{2}$ in. long, with coarsely toothed margins and petioles to 4 in. long.

Found in moist ground, commonly in the shaded areas such as at woodland borders, from Nova Scotia to Georgia, west to Saskatchewan and Kansas. Closely related to spotted touch-me-not with orange and yellow flowers, somewhat smaller and possibly somewhat more common in many parts of range. Also related to greenhouse balsam.

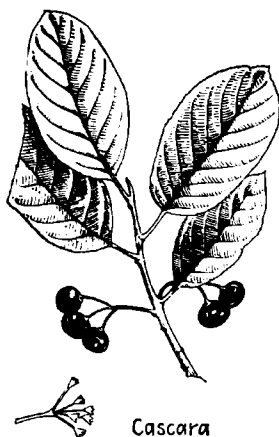
Flowers pale yellow or sometimes dotted with red-brown, to $1\frac{1}{4}$ in. long, suspended at end of slender stem arising from a leaf axil, like a funnel-shaped sack somewhat closed at larger end, with a curved spur at smaller end in which there is nectar. Fruit a slender capsule about 1 in. long that bursts, freeing dark-brown seeds.

Flowers from July through September. Pollination effected probably by bumblebees and honeybees powerful enough to force way into semiclosed flowers and reach nectar sac, which in this species is about $\frac{1}{2}$ length of flower. Stem commonly contains larva of a borer that eats its way through the joints.

An attractive plant found abundantly at woodland borders. Seeds delicious tidbits, tasting much like butternuts. Stamens develop as a rule before pistils. Plants are considered fairly emetic and poisonous if eaten by stock in fresh condition.



Buckthorn



Cascara



New Jersey Tea

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rhamnales. Family Rhamnaceae

Buckthorn

Rhamnus caribartica

Shrub. Height to 20 ft. Lateral twigs may end in short stiff stout thorns. Bark, dark. Leaves alternate, smooth, to 2½ in. long and 1 in. wide, oval, well-petioled, blunt or acute at tip, with margins with shallow rounded teeth, with rather conspicuously paired veins, deciduous, dark-green above and lighter beneath.

Native of Europe and western and northern Asia but widely planted in America as a hedge plant and often escaped and established in many places. About 100 species of the genus in the world, found largely in temperate and the warmer regions. Does well on dry soil. Related *R. frangula* yields high-grade charcoal used in making gunpowder.

Flowers of 2 kinds, with staminate and pistillate on separate plants, clustered in axils of leaves, greenish, appearing shortly after leaves, with narrow, relatively inconspicuous petals. Stamens 4 to a flower. Fruits a small globular black cherry-like structure, to ⅓ in. in diameter, with 3-4 grooved nutlets.

Relatively common hedge and fence-row plant, the seeds being planted by birds. Propagated mostly by seeds that are collected in fall, stratified in sand for winter, and sowed in place in spring. Related evergreen species propagated by cuttings of mature wood. Fruit yields the dye Chinese green.

Bark, leaves, and berries have strong purgative qualities but because of bitter taste they are rarely eaten. Dried bark of related *R. purshiana* from a western shrub is described elsewhere. Related *Karwinskia humboldtiana* or coyotillo has berries that if eaten may cause a paralysis of hind legs of domestic cattle.

Cascara

Rhamnus purshiana

Tree. Height to 60 ft. Trunk diameter to 20 in. Bark close, mottled, usually under ¼ in. thick, dark or light brown, often tinged with red and broken into small thin scales on surface. Winter buds naked, hoary or fuzzy. Leaves alternate, almost entire, to 2 in. wide and with prominent midrib and branching veins.

Native of Northwest. Ranges from southern British Columbia, northern Washington, and the Puget Sound region to Idaho, Montana, and south to central California and southern slope of Grand Canyon in Arizona. Western North America has monopoly on drug. Early Mexican and Spanish priests in California learned of its use from Indians.

Flowers relatively inconspicuous, hung on slender stems from axils of leaves. Corolla minute, of 5 petals. Fruit like small black 2-3-seeded cherries, to ⅓ in. through, with a thin juicy flesh; with nutlets flattened on inner face and with a thin gray shell. Inner surface of thin seed coat is bright orange.

Since 1877 cascara has had official listing as a helpful drug. Bark peeled from woody parts down to 2 in. through, though that of older trees is superior. Bark cured for 2 years is best. Trees peeled should be left with live bark near base and cut to encourage new sucker shoots. If under 5 in. through they should not be cut.

Drug cascara sagrada produces the constituent frangulin, a mixture of frangulic acid, emodin, and a bitter resin, the latter being modified in some fluidextracts by magnesium oxide. Drug a standard cathartic and tonic, used widely in military forces, an official drug plant. A 3-in. tree may yield only 5 lb. of bark.

New Jersey Tea

Ceanothus americanus

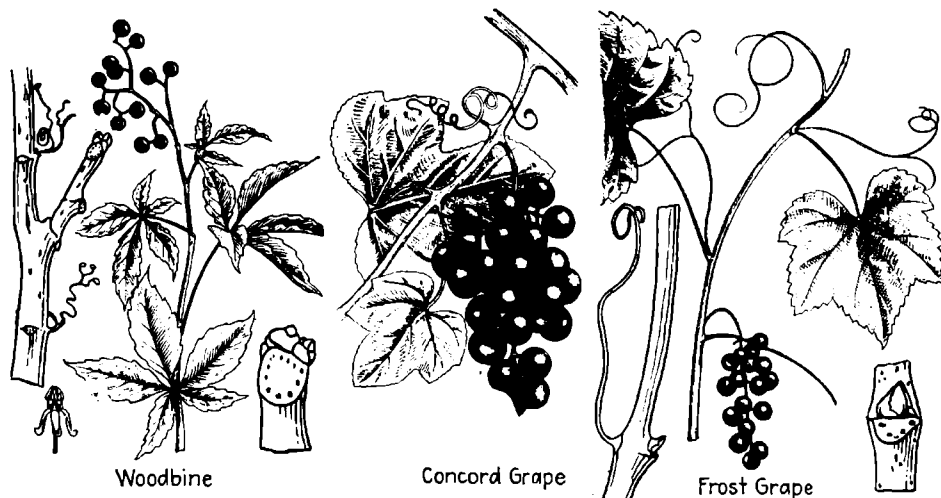
Shrub. Height a few feet. Densely branching, with parts erect or ascending. Root system deep, red, with especially well-developed taproot. Leaves alternate, to 3 in. long and to 1 in. wide, obviously with 3 main veins, with petioles to ½ in. long, pointed at tip, rounded at base and with finely toothed margins.

Found in dry woodlands or exposed rocky areas. Ranges from Maine to Florida, west to Manitoba and Texas reaching an elevation of 4,200 ft. in North Carolina. Some 55 species in United States and northern Mexico including *C. integrerrimus* or deer brush, an important browse in the West, and *C. leucodermis* or chaparral, a whitethorn useful to mule deer.

Flowers in dense clusters, with a number of clusters at ends of branches or arising from leaf axils, small, white, on short stems, to ½ in. long and arising more or less from a common point. Fruit like a flattened sphere that becomes black and is to ⅓ in. high and wider than this; dry, producing 3 smooth nutlets.

Root system penetrates deeply into clay, sand, limestone, sandstone, and other soils and provides a superior soil anchor with the dense brushy tops serving to anchor wind-blown material. Most of the *Ceanothus* species seem able to recover after a fire, probably in part because of substantial root system.

Leaves and twigs collected when they are just reaching full size may be dried quickly and used as a tea substitute. Many western species are trees of considerable size and provide browse for cattle, deer, rabbits, porcupine, beaver, and other mammals and food and cover for quail and other birds. Red root yields an excellent dye.



Woodbine

Concord Grape

Frost Grape

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rhamnales. Family Vitaceae

Woodbine, Virginia Creeper
Parthenocissus quinquefolia

Woody vine. Climbing 20 or more feet by means of tendrils that bear at the end of 5-8 branches some adhesive discs that grow firmly to wood, brick, or stone. Leaves alternate, of 3-7 but usually 5 leaflets, each to 6 in. long and coming from a common point at end of a rather long petiole. Leaflet margins rather coarsely toothed.

Found on fences, walls, buildings, climbing trees, or in thickets or on the ground from Quebec to Florida and west to Saskatchewan, Texas, and Mexico and grown rather extensively as a hardy climbing ornamental. Found wild in Cuba and the Bahamas. About a dozen species native of eastern North America and Asia.

Flowers inconspicuous, yellow-green to white, with pistils and stamens in same flower or with pistils and stamens in separate flowers on one plant, borne in an open broad cluster that expands to bear by fall attractive 2-3-seeded blue berries to $\frac{1}{2}$ in. in diameter, with their stems becoming red.

Found on sand, loam, clay, and a variety of soils. Resists grazing rather well. Seeds run 12,000-19,000 per lb. Easiest propagation usually by cuttings, stems rooting easily in proper soil or layering naturally and establishing a plantation over a considerable area.

Leaves turn a beautiful scarlet in fall. This 5-leaved ivy is not to be confused with poisonous 3-leaved ivy, since while this may sometimes bear 3 leaflets the poison ivy never bears more than 3. Berries or other parts eaten by turkeys, pheasants, quail, grouse, prairie chicken, deer, chipmunks, and other birds and mammals.

Concord Grape
Vitis labrusca

Heavy, woody vine, climbing by tendrils and rooting freely with contact with ground. Leaves as broad as long, with blade to 8 in. across, alternate, with 3 obscure lobes at apex, dark-green above and gray felty beneath, with a petiole nearly as long as blade's diameter.

Derived from native fox grape *V. labrusca* whose range is from New England to Georgia, west to Indiana. Other grapes from same source include the Worden, Hartford, and Vergennes while the Catawbas, Niagaras, and Isabellas result from crosses between *V. labrusca* and *V. vinifera*. Labruscan leaves are usually more felty beneath.

Flowers relatively inconspicuous, borne at about time leaves appear and at base of current year's growth. Flowers like small greenish cups, actually or functionally either staminate or pistillate. Fruits well-known, soft, blue, juicy berries, with many seeds embedded in a juicy sweet pulp.

Pruning commonly cuts canes to 8-10 buds each, with 3-4 canes to a vine and with most 2- and 3-year-old wood cut away. In East, commonly trained on a 2-wire trellis. Vines may produce to 60 bunches weighing to 20 lb. Fruit rots and mildews controlled in part by bordeaux mixture, and grape rootworm by lead arsenate.

Fruits have considerable quantities of vitamins B and C. A food portion of 4.8 oz. equals a 100-calorie portion. Yield may be as much as 5 tons per acre. Sold fresh, for extraction for juice, either unfermented or fermented into wine. In some forms, as in the raisin grapes, fruits are dried. Many wild grapes supply important game food.

Riverside or Frost Grape
Vitis vulpina

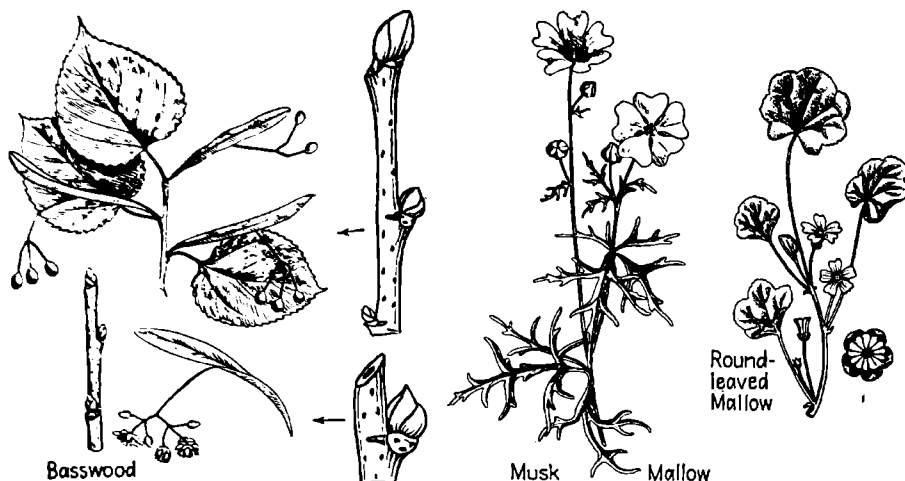
Climbing, trailing, woody vine. More or less smooth throughout. Bark scales off in long strips. Branches rounded, angled, green, with pith interrupted and with tendrils. Leaves alternate, shining, 3-7-lobed, with notches angular and points acute but with terminal lobe largest.

Common by streams and woodland borders from New Brunswick to Maryland, west to Manitoba, Kansas, Colorado, Texas, and West Virginia. About 50 species of wild grapes known, of which half are American and of these about $\frac{3}{8}$ are native of eastern part. Species vary greatly in leaf shape, fruit, bark, and other characters, and may cross freely.

Flowers: staminate, with stamens that are erect or nearly so; those with both stamens and pistils, with downward-curved stamens borne on medium-large, rather open clusters, fragrant. Fruits, bluish-black, to nearly $\frac{1}{2}$ in. in diameter, with 2-4 seeds, with a bloom, acid and very juicy, ripening from September through November. Flowers in May and June.

Grows well in well-drained, loose, sandy soils; poorly in lime or clay soils. Roots long, thin, hard, fibrous. Plant resistant to *Phylloxera* and to cold but not to heat and drought. Propagated easily by cuttings, 85% of which usually root readily, easily grafted. Seeds germinate quickly and readily and weigh 14,500 per lb.

Commonly used in Europe as a base for grafting *V. vinifera* and other domestic stock. Fruit constitutes more than half of total fruit food of pheasants in Michigan and 4% of their total food. Also eaten by grouse, deer, cottontail, skunk, fox, wild turkey, mourning dove, quail, cedar waxwing, and other forms of wildlife.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Malvales

Family Tiliaceae

Basswood, Linden *Tilia americana*

Tree. To 80 ft. high. With trunk to 4 ft. in diameter. Crown dense and rounded. Trunk straight and slightly tapering, with dark-gray, somewhat scaly, deeply and regularly fissured bark. Leaves alternate, simple, unequally heart-shaped, with incurved marginal teeth; texture, firm. Roots lateral, deep, spreading, without taproot.

A close relative of linden. Family has about 370 species. Found from New Brunswick to Manitoba, south to Georgia and eastern Texas and is usually rather abundant within its range though it does not occur in pure stands. It favors rich woods and loamy bottom lands.

Stamens and pistils in fragrant, yellowish-white flowers borne in flat drooping clusters in June and July. Pollination by insects, particularly bees, results in woody, spherical, pea-sized fruits, attached singly or in groups, on a wing, and distributed in October or fall by the wind. Seedlings 1-2 in. high first year; with two 4-5-lobed palmate cotyledons.

Rarely attacked by fungi but sometimes by a canker of bark and a leaf spot and by an insect pest, the basswood leaf roller. Propagated by seed, stratified when ripe and planted in spring. Dry seed may germinate after 2 years. Seeds 5,000 per lb., germinate 10-15%. Grows better in a mixed forest than alone and does not resist wind injury well or severe ice storms.

Inner bark yields a cordage fiber; whole bark used by farmers for tying logs together. Inner bark has some edible qualities, and buds are good to eat. Wood valuable as "whitewood," light, soft, moderately strong, fine-grained, white, weighs 28 lb. per cu. ft. Flowers with help of bees yield a superior honey. Staple food of cottontail and white-tailed deer.

Musk Mallow *Malva moschata*

Height to 2 ft. or even more. Branching, covered with long fine hairs or smooth and erect. Leaves alternate, to 4 in. wide. Basal leaves with 5-9 broad rounded lobes and long petioles. Stem leaves deeply cut into repeatedly cut divisions. Root system substantial, with a deep branched or unbranched taproot and finer roots.

Naturalized from Europe but escaped from cultivation or as a weed impurity. Now well-established sometimes as a weed from Nova Scotia to Virginia, west to British Columbia and Oregon. Sometimes planted in wild or semiwild gardens as persistent attractive plant. Closely related to round-leaved mallow or cheeses.

Flowers to 2 in. broad, borne in showy clusters at tip of plant or in axils of upper leaves, white, pink, or sometimes somewhat bluish, with delicate petals that are 5-8 times as long as green sepals. Fruit composed of to 20 segments, rounded on back, densely hairy, and enclosed in calyx when mature.

Flowers in June through August and produces seeds succeeding months. Survives in midst of tall grass and may decrease value of hay where it is an established weed. Control is by keeping tops cut before seeds have time to form and digging out perennial and rather large root systems.

Flowers grown in wild gardens for ornament and are used to a slight extent for bouquets in spite of the fact that they are inclined to wilt quickly after they have been picked. Delicate musk odor of flowers gives them added attractiveness.

Family Malvaceae

Round-leaved Mallow *Malva neglecta*

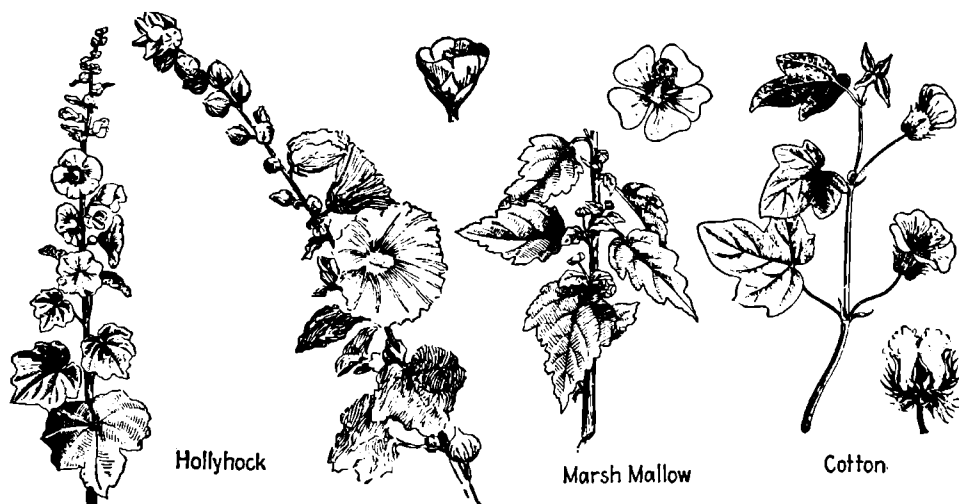
Height to 2 ft. Usually a sprawling plant covering a square yard or more. Stems round, smooth, branched, green. Leaves with blades round or heart-shaped, with toothed or scalloped edges and to 6-in. petioles. Blades to 3 in. across, 5-9 lobed. Root system deeply penetrating. Whole plant tough. Stem and root not easily separated.

Common in waste places, on poor lawns, and in neglected gardens usually at best in relatively dry areas. Ranges through North America except in extreme north. Native of Europe and Asia, but widely established in other parts of world. Persistent once it has become established anywhere. 30 species in the genus, mostly Old World.

Flowers 5-parted, with pale lavender or white delicate petals. Stamens fastened together into a tube and at first enclosing the blue-tipped pistils that eventually emerge from the top of the stamen tube. Pollination effected by insects or by self. Fruits a disc-like collection of cases, each containing 1 flat seed.

Flowers from May through October. Fruits from June through November though flowers and fruits may be found at any time of the year. Seeds long-lived and may persist in soil many years. Deep roots help plant survive drought. Mucilage in seeds helps them get a start in germination and makes them desired by children who chew the "cheeses."

Plant reported to have medicinal properties of an obscure nature. Tender shoots eaten as salad in France. Greeks, Romans, Egyptians, and Mexicans use the whole plant as a potherb like spinach. Young plants properly cooked are good as greens. 2 flies live as leaf miners. Fruits eaten by birds and by a few insects.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Malvales. Family Malvaceae

Hollyhock
Althaea rosea

Height to 9 ft. With erect unbranched spire-like hairy stems. Leaves deep green above and lighter beneath, alternate, rough, lobed, long-petioled, rather thick, with wavy margins and relatively conspicuous veins, often spotted with disease marks. Root system heavy, deeply penetrating, and often branched, with short side-crown buds.

Native of China. Carried to Europe by the Crusaders; to America by the Pilgrims; now commonly established throughout United States and through much of temperate world. Sun-loving but tolerates partial shade. Lower leaves demand light. Grows best in well-drained fertile soils. About 15 species in the genus. Closely related to marsh mallow.

Flowers nearly stemless but arranged in a wand-like formation along main stem; large, single or double; to 3 in. or more across, many-colored. Many stamens fastened into a tube at base through which pistils thrust. Fruit a capsule with many seeds. Blooms July to September, each flower lasting 3-4 days. Perennial or biennial.

Propagation by seeds or by division. Seeds germinate in 5 days and may live 4-5 years dry. Self-sowing maintains production but plants hybridize freely. Sow seeds in fall, cover lightly in deeply dug soil, transplant in spring, mulch in fall. Insect pests include rose chafer, stalk borer, abutilon moth, leaf roller.

Excellent ornamental perennial or biennial for growing near walls and borders. Popular with amateur plant breeders. Occupies little space horizontally but much vertically. Insects controlled by picking or lead arsenate spray; destructive rusts, by bordeaux spray or sulfur dusting; red spiders, with a water spray. Some varieties resistant.

Marsh Mallow
Althaea officinalis

Height to 4 ft. Erect, downy, leafy stems. Leaves heart-shaped or oval, 3-lobed or undivided, densely fuzzy, alternate, conspicuously veined and inclined to curl rather than to lie flat. Root system substantial, deeply penetrating, brown-barked but lighter within and not too tough.

Native of Europe but escaped in America and sometimes established at edges of marshes such as the salt marshes of New England. Now considered established from Massachusetts to Pennsylvania and reported in Michigan, Arkansas, and District of Columbia. Little cultivated in this country.

Flowers pink, about 1½ in. across, borne terminally and in axils of leaves, showy because of colored, relatively thin petals, usually in clusters of a few though clusters are well-distributed over upper parts of plant. Fruit composed of 20 sections, fuzzy. Seeds like flattened thin sections of an apple.

Brown bark of root contains 1% asparagin, 25% bassorin (mucilage), 10% pectin, and 8% sugar when dried. Roots collected when 2 years old. Mucilaginous properties demonstrated in marshmallow confection so well-known.

Used in medicine as a demulcent. Common names include "mortification root" and "sweatweed." Leaves sometimes used as poultices but mucilage of the roots finds best use as a soothing agent for inflamed tissues. Plant is sometimes grown as an ornamental because of its attractive flowers.

Cotton
Gossypium hirsutum

Height to 8 ft. Much-branched but with one more or less central stem. General shape of plant like a cone. Leaves variable, to 6 in. long and 5 in. wide, heart-shaped, 3-7-lobed, and coarse-veined. Roots a main taproot, with finely divided lateral roots that fill the soil. Sometimes called herbaceous shrub. Annual.

American cottons include upland cotton, *G. hirsutum*, Sea-island cotton, *G. barbadense*, Peruvian cotton, *G. peruvianum*. Asiatic cottons include Bengal cotton *G. neglectum*. Upland cotton constitutes about 99% of all cotton grown in the United States and is of course leading crop in the Southern states.

Flowers on short stems, creamy white at opening, changing to red by second day. Sea-island cotton has yellow flowers. The bolls which develop from flowers may be 2½ in. across, and a good plant may bear 50 bolls. Seeds 1-3 bushels per acre, planted 2 weeks after last killing frost produce plants that in September to November may yield mature cotton.

Requires about 200 days, with a mean temperature in summer of around 77°F. and rainfall, after harvest, of about 10-22 inches. May and June are critical months, and a rainy fall may ruin a harvest. Seed hairs vary in length, strength, and fineness in different cottons. Cotton boll weevil has been most important insect pest.

World's most important fiber crop, having been used since 1000 B.C. In United States next in importance as an agricultural crop to wheat, potatoes, and corn but leads in areas between 30-40° north or south of the equator. Cottonseed valuable in industry for food and oil. 2 million acres of cotton in United States yield about 10 million bales.



Flowering Maple



Velvet Leaf



Jute

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Malvales. Family Malvaceae

Flowering Maple *Abutilon hybridum*

Shrubby. Stem erect, stiff, rather coarse. Leaves alternate, somewhat lobed, resembling some maples superficially, coarse, prominently veined, long-petioled but varying greatly from obovate to unlobed, smooth to fuzzy, large to small, and so on. Root system fibrous and branched.

A hybrid of many species including such garden varieties as snowball, fireball, caprice, Savitzii, golden fleece, and others. Some 100 species of herbs and shrubs in the genus, many native of South America. Commonly grown in greenhouses or coolhouses or as summer border plants or sometimes as house plants.

Flowers red, purple, pinkish, yellow, white, or mixed in color; open, drooping from slender stems at tip of plant or its branches, relatively light-sensitive. Stamens many, fastened together at base, at first enclosing pistils but later freeing them through tip. Seeds sown in spring yield large blooms in autumn.

May be propagated by slip taken in spring or autumn as well as by seeds. Plants taken into greenhouse in September may be cut back and grown at 55°F. but bottom heat is necessary for satisfactory development. Mealy bugs, red spiders, thrips, and aphids are bad pests controlled by sprays, fumigation, and picking.

High nitrogen content of soil produces heavy foliage and few flowers so low fertility is favored where plants are grown as house plants or for window boxes. Shrubby ported plants have a fair popularity for sick and will bloom all winter if given care but of course cannot survive severe weather outdoors in the North.

Velvet Leaf, Indian Mallow *Abutilon theophrasti*

Height to 6 ft. Erect, branched above, rather stout, densely velvety. Leaves with a strong odor, velvety, with a heart-shaped blade that may be to 1 ft. across, nearly entire, with a drawn-out point at the tip or blunt, conspicuously veined, with petioles about as long as blade is wide. Deeply penetrating roots.

Locally common in waste places, vacant lots, cornfields, barnyards, and similar localities through most of United States and southern Canada particularly in warmer areas. Some 100 species of genus to be found in tropical areas, but this is most common one to reach into temperate zones.

Flowers yellow, to 3/4 in. across, drooping or erect bells, solitary, on rather stout stems that are shorter than the petioles. Stamens united in a column enclosing pistil tips. Fruit an interesting, many-chambered capsule that frees seeds from tip. Seeds gray-brown, thinned on one side.

Flowering time from August through October. Propagated by seeds only. Seeds known to retain their living qualities for 60 years, so once soil has been well-supplied with these seeds, it may continue to yield plants almost indefinitely. Control of course centers around destroying the first plant before it bears seeds.

This is sometimes a serious weed in crop fields but it succumbs to cultivation and pulls easily. It was considered as a possible source of fiber to substitute for manila and sisal but cannot rival these plants. Known as butter print, mormon weed, Indian hemp, American jute, cottonweed, pieprint, piemarkar, and buttonweed.

Indian Jute *Corchorus capsularis*

Height 15 ft. Stems straight, branching only near top. Stem diameter to 1/2 in. Leaves shaped somewhat like an arrowhead, to 4 in. long, with basal teeth sharply pointed. In *C. capsularis* leaves are bitter and seed pods spherical; in related *C. olitorius*, Desi or Nalta jute, leaves are not bitter and seed pods are cylindrical. Annual.

More than 20 races of Indian jute known. Requires a rich loose, sandy soil, with good drainage and climatic conditions such as are to be found in Burma, Bengal, southern China, north-eastern India, and the southern islands of Japan. Does best on high lands but is grown on lands that are flooded in late summer season.

Flowers small, yellow, often solitary, mallow-like, with 5 petals, 5 sepals, and 10 or more stamens, which are free of each other. Seeds sown by hand, 10-15 lb. to the acre, March to May. Cultivated when plants are 6 in. high, and hoed thereafter. Harvested from flowering time to maturity, the earlier the better commercially.

Plants cut, then held under water at about 80°F. for 10-20 days, after which fiber is extracted by running to 3 stalks at a time through the fingers, a woman being able to strip to 40 pounds a day, for which the wage has been the waste fiber to be used as fuel. Yield about 1,300-1,800 lb. per acre. Exported in 400-lb. bales.

In normal times, India grows about 3 million acres of jute. Normal world yield between 1-2 million tons. Used in making burlap sacks, coarse cordage, twines, and some coarse papers. In commerce, the material is known as Bengal gunny, the short fibers being used in papermaking and the long fibers being twisted or spun into cordage and similar materials.



Bladder
Ketmia

Flower-of-
the-Hour



Rose of Sharon



Spiny Sida

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Malvales. Family Malvaceae

Bladder Ketmia
Hibiscus trionum

Height to 2 ft. Erect or rather weakly so, branching freely, covered with rather fine spreading hairs. Leaves long-petioled, with blades rather circular in general outline but deeply lobed or divided one or more times into 3-7 lobes, with the middle one the longer. Root system rather deeply penetrating. Annual.

Found in rather open dry waste places. Native of southern Europe. Now rather well established in fields and near grain plantings from Nova Scotia to Florida, west to South Dakota and Kansas. Possibly more abundant in western part of this range. Closely related to rose of Sharon, rose mallow, and similar plants.

Flowers attractive, showy, pale yellow with dark-purple centers, to 2½ in. across. May fade from a deep sulfur yellow to a pale weak yellow or petals may be purple-tipped at outer edge. Calyx 5-angled, almost globular, hairy, conspicuously veined, and like "spun glass." Fruit a globular capsule containing many roughened dark seeds.

Flowers from July through September. Does best on gravelly or limy soils. Seeds retain life long, either buried in soil or may survive in silage. Since reproduction is by seeds alone, every effort should be made to prevent the plant going to seed, because once a seed supply is established in soil the plant may persist for years.

Control is by means of hoeing, pulling, and cultivating as late as crop will permit. Plant entitled to place in flower garden but should be kept there as it does not improve fields where it may become established. Known as modesty, shoofly, Venice mallow, black-eyed Susan, devil's-head-in-a-bush, flower of an hour.

Rose of Sharon
Hibiscus syriacus

Tree or shrub. Height to 12 ft. Branches freely. Has dark bark and is nearly smooth throughout. Leaves alternate, somewhat triangular, dark-green, conspicuously 3-ribbed, to 3 in. long; lower ones inclined to be 3-lobed, margins rather coarsely but shallowly toothed and notched. Leaves give plant beauty as an ornamental even without flowers.

Native of eastern Asia, cultivated under many names depending on time and color of flowering, shape and coloring of leaves, and other characters. Relatively common as a lawn or hedge ornamental as far north as the Canadian border and into Ontario, though all varieties are not equally hardy.

Flowers to 3 in. or even more across, single or double, showy, short-stemmed, commonly rose or purple though other colors are known, usually darkest near base, borne in axils of leaves on young wood of year but late in the season. Fruit about 1 in. long, short-beaked and splitting into 5 valves to free the seeds.

Flowering time summer and early fall. Propagation by seeds or by cuttings of wood that has ripened by fall, these cuttings being rooted in greenhouses through winter for spring planting. Plants are also grafted rather easily, this making it possible to retain unique varieties that might not persist through the seed stage.

A generally popular ornamental closely related to hibiscus so commonly planted along roadsides of tropical countries. A number of perennial herbs such as swamp rose mallow *H. moscheutos* that are hardy in North and many other shrubs, trees, and herbs that have attractive flowers and other pleasing qualities.

Spiny Sida
Sida spinosa

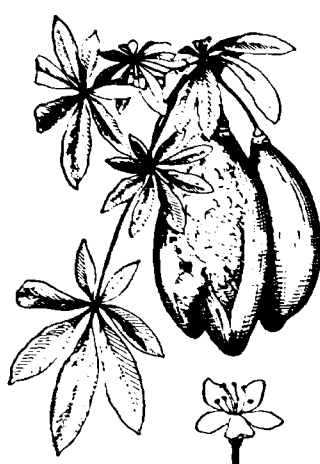
Height to 2 ft. Erect herb that branches freely and is covered with fine soft hairs. Leaves alternate, with blade and petiole totaling to 2 in. long and blade to nearly 1 in. wide with curved teeth along margins and with soft hairs such as are found on stem. Petiole somewhat shorter than blade.

Locally common in waste places and, unfortunately, in cultivated fields from Maine to Florida west to Iowa, Kansas, and Texas, being possibly more common in western part of this range; probably spreading. Has wide distribution in tropical America whence it is supposed by some to have moved north.

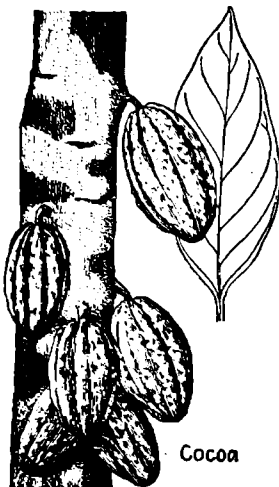
Flowers borne in axils of leaves usually singly, yellow, to ½ in. across and thus relatively inconspicuous, on short stems. Calyx encloses much of the flower and is conspicuous because of its rather sharp teeth that are about equal to end of petals. Fruit composed of 5 sections, each of which frees a red-brown seed.

Blooms June through September. Annual. Propagates solely by seeds that are long-lived, in soil or out. For this reason, control requires cutting of plant before it has had time to sow a crop of seeds which may continue to produce plants for a number of years. In South, it may be a serious weed in certain areas.

Seeds rather commonly found as impurities of commercial seeds. Control measures are largely limited to cultivation and hand pulling though sprays are useful, in part because fuzzy covering of the plant holds them until they may become effective.



Silk Cotton Tree



Cocoa



Tea

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Malvales.

Family Bombacaceae

Silk-cotton Tree, Kapok *Ceiba pentandra*

Tree. Height to over 100 ft. Trunk enormous, with giant buttresses that stick out to 30 ft. in various directions and extend upward for considerable distance. Branches more or less horizontal and sometimes spiny. Leaves compounded of about 7 leaflets, each to 6 in. long and arising from a common point. Root system relatively shallow but widespread.

Family includes baobab tree *Adansonia*, of Africa, India, and South America, whose trunk is probably larger than that of any other tree. Also in the family is the balsa *Ochroma* and the durian *Durio*. *Ceiba pentandra* is a native of the tropics of Asia, Africa, and America and is grown sparingly in southern Florida and in southern California.

Flowers with corolla to 3 in. long, with the white or rose petals distinctly hairy on the outside and with the calyx cup-shaped. Fruit important, to 8 in. long, shaped somewhat like a plump banana but composed of 5 sections that break at maturity to free the many seeds, whose woolly covering is probably hidden in pillows in most homes in America.

Tree begins to yield fruits when only 15 ft. high. A mature tree may bear to 1,000 pods yielding a total of about 10 lb. of cottony floss that is white, yellowish, or brown and water-resistant but cannot be spun into threads. Wood soft, white, brittle. Seeds contain to 23% of a fatty oil extracted for soap and for food.

Kapok floss, of which the United States imports annually some 10,000 tons, is used for life preservers, sleeping bags, mattresses, pillows and upholstery. Java, the Philippines, and Ceylon are the chief sources of supply. Natives of Jamaica believe that the duppies or "little folk" live in the huge buttresses of the trees, where they are seen only by the believers.

Family Sterculiaceae

Cocoa *Theobroma cacao*

Tree. Height to over 25 ft. Twigs rather coarse and fuzzy. Branches wide-spreading, particularly in wild plants. Leaves evergreen, to over 12 in. long, leathery, conspicuously veined, more or less entire, with short petioles and a rather short point at the tip, usually hanging rather conspicuously downward.

Native of Central America and northern South America, being grown rather extensively there and in the West Indies. Lends itself easily to cultivation. A close relative is the cola or goora nut, from which a popular soft drink is prepared and which lacks petals such as are present in cocoa plant. Over 40 varieties of cocoa.

Flowers borne in clusters directly on bark of trunk and main branches, each on slender stems to over $\frac{1}{2}$ in. long. Flowers have rose-colored calyx, yellowish petals, and are to $\frac{3}{4}$ in. across. Fruit an elliptic red, purple, or brown pod with hard thick walls, to 1 ft. long and 4 in. through, with flat 1-in. seeds.

Seeds washed or fermented to remove mucilaginous coat and pinkish or white pulp that adheres to them. Single fruit may yield to 60 seeds. Trees begin to bear at 4 years and may yield to 50 years. Fruits ripen in about 4 months. Extracted seeds are roasted at 257–284°F. and ground to a paste. Oil is removed by pressure.

Seeds contain under 1% alkaloid theobromine and a trace of caffeine, 30–50% fatty oil, 15% starch, and 15% protein. Sweet chocolate made by adding sugar and spices; milk chocolate, by adding milk and spices; cocoa, by removing $\frac{2}{3}$ of fatty oil by pressure; cocoa butter from the oil used in cosmetics. Wastes used as fertilizers and cattle food.

Order Violales

Family Ternstroemiceae

Tea *Camellia sinensis*

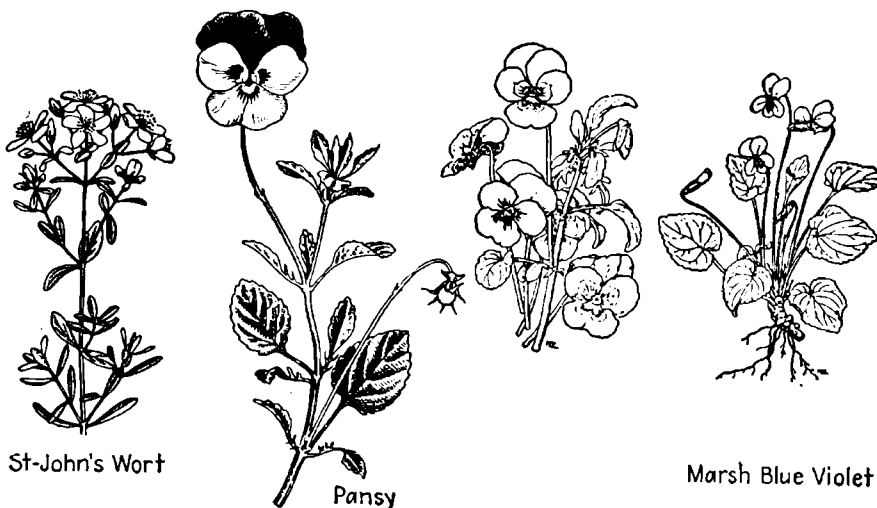
Tree or shrub. Height to over 30 ft. Mostly smooth. Leaves alternate, evergreen, to 5 in. long, fuzzy beneath, when young, blunt or acute, somewhat toothed on margins, short-petioled, with pointed tips. Leaves quite different in given varieties, varying from dark to light green and considerably in shape and size.

Native of China and India but widely cultivated in suitable territory. About 14 species in tropical and subtropical Asia. Grown only rarely as curiosities in America. Closely related to camellias grown for their attractive flowers. Loblolly bay or tan bay of Virginia a close relative.

Flowers white, fragrant, showy, of 5 petals, to $1\frac{1}{2}$ in. across, with many stamens and with a many-celled pistil that is short and hairy and breaks, freeing 1 large seed from each cell. Seeds sown in fall grow into seedlings that are transplanted following spring, developing to yield first crop in 4 years; full crop in 10 years.

Requires 60–200 in. of rainfall annually. Can be grown from sea level to 5,000-ft. altitude. Known to live 200 years. Pickings may be made from 4–30 times a year. Acre may yield to 1,000 lb. a year over period of more than 50 years. Tea contains 2–5% alkaline theine and 13–18% tannin.

Grade of tea depends on age of leaves. Young buds yield golden tips; smallest leaves, orange pekoe; second leaves, pekoe; third leaves, pekoe-souchong; fourth leaves, souchong; and fifth leaves, congou. Leaves for black tea are fermented after being covered and kept warm, while green teas are cured in sun or by rolling with hands or machines.



St-John's Wort

Pansy

Marsh Blue Violet

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order *Violales*

Family *Hypericaceae*

St. John's-wort
Hypericum perforatum

Herb. Perennial. Height to nearly 3 ft. Stem erect, tough, slender, wiry, much-branched toward top; many arising from common base and its runners. Stems flattened somewhat. Leaves opposite, entire, showing minute translucent dots when held to light, to 1 in. long, speckled. Root system tough, strong, deep.

Common weed in fields, waste places, and pastures where it is eliminated with difficulty once it is well-established. Naturalized from Europe. Well-established in Canada and the United States except in extreme northern and southern portions. Some 200 species in the genus, with wide geographical distribution.

Flowers yellow, to 1 in. broad, crowded at top of plant, erect, with 5 petals and a great tuft of black-dotted stamens more or less separated into 3 groups. Fruits persistent capsules filled with enormous numbers of small cylindrical dark-tan seeds that shake free with the swaying of the plant.

Juices sour and blistering. Plant is therefore usually unpalatable and not eaten by cattle. It then survives to multiply. If cattle are forced to eat it because of lack of other fodder, a poisoning effect may result particularly in unpigmented skinned cattle that must remain exposed to the sun.

Plant can best be eliminated by persistent hand pulling or by frequent plowing and close cultivation sufficient to destroy the runners. Hay is unsatisfactory as food for cattle. Poisoning due to photosensitizing agents, hypericin and hypericum red. Affected cattle and sheep get high temperature, rapid pulse, diarrhea, and dermatitis.

Pansy
Viola tricolor

Herb. Height to about 6 in. Sprawling, smooth, weak-stemmed, branched, green, erect at tips. Leaves petioled, with broad, heart-shaped blades on basal leaves and more oval blades on those arising from upper part of stem, with conspicuously large divided stipules at bases of leaves.

One of most popular annual garden flowers, long known under cultivation. Derived from violets. Escaped from cultivation, flowers become small and lose showy coloring of garden plant. Some writers think it should have a species separate from *V. tricolor*. More than 300 species of violets.

Flowers erect, showy, mostly blue, white, or yellow, with petals making a broad "face," with a spur to rear that is about twice as long as calyx parts. Some flowers remain close to ground and do not open yet produce fertile seeds (cleistogamous). Fruit a capsule that splits to free large numbers of small brownish seeds.

For spring blooms, seeds are sown in cold frames in August, then transplanted to 3 in. apart. Protecting mulch of straw on branches allows plants needed air and prevents crushing. If this is removed gradually in spring, flowers should appear early. Flowers should be picked and seeds should not be ripened if blooming period is to be long.

Flowers picked in early morning before visiting insects have effected cross-pollination last longer than those picked after pollination has taken place. For summer and fall flowers, seeds may be sown indoors in boxes from February to June. A moist pansy bed fertilized with well-rotted manure produces superior blooms.

Family *Violaceae*

Marsh Blue Violet
Viola cucullata

Annual. Weak, sprawling, green, the sprawling stems branching to yield tufts of leaves on relatively short stems. Leaves petioled, with heart-shaped blades that are rich green and sometimes to 3½ in. broad when mature, with rather conspicuous veins and margins with shallow, rounded teeth. Stout rootstock but no runners.

Native in America. Found in wet places where soil is appropriate from Quebec to Ontario, south to higher parts of Georgia. Closely related species extend range westward. Some 300 species of violets. Garden pansy is a violet. Sweet violet of the garden and greenhouse is *V. odorata*.

Flowers borne on stems that are longer than the leaves but in this species there is no true erect stem; violet-blue, darker colored at throat or sometimes white, with a conspicuous beard at throat but with spurred petal smooth and somewhat shorter than those at the side. Some flowers do not open to mature seeds.

Pollination effected mostly by bumblebees that touch stigma of pistil before they reach pollen-bearing stamens. While this species blooms normally in spring, violets may be kept blooming year round if each day they have an amount of light similar to that of their normal flowering time.

Popular spring bouquet flowers. Flowers may be picked with little harm to plant unless whole leaf cluster is torn free. Since plant is not an annual, it is not dependent solely on seeds to maintain an existence from year to year. Violet is State flower of Illinois, Rhode Island, Wisconsin, and New Jersey. Commercial perfume extracted from *V. odorata*.



Violet



Begonia



Rex Begonia

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Violales

Family Violaceae

Sweet White Violet

Viola blanda

Herb. Height to under 6 in. Stem long and slender, producing slender runners from ends of which arise tufts of leaves and flowers. Runners are branched, thus enabling plant to occupy considerable territory. Leaves alternate, on long petioles that may be tinged with red, with heart-shaped blades, usually under 2 in. broad.

Native of America. Found mostly in cool, shady moist places such as ravines in clumps of rich soil. Ranges from western Quebec and New England to northern Georgia, west to Minnesota, with closely related species extending range particularly to the west.

Flower white, small, fragrant, without a beard on the petals, with upper pair rather longer and narrower than is typical of violets and also often bent backward or twisted as shown in illustration. Some flowers do not open to produce fertile seeds but remain close to ground. Fruit a purple capsule bearing many brown seeds.

Flowering time April and May, usually a little later than earliest violets. Pollination effected by honeybees and other bees such as *Halictus* that are attracted probably by fragrance and conspicuous character of flowers, even though they are small for a violet.

An attractive spring flower that does not yield well to transplanting probably because transplanting is usually to an unsuitable site. *V. cucullata* seems to establish itself readily in a variety of places but not this species. Violets were cultivated as potherbs in Egypt. Shoots are eaten for salad in France and Italy. Pythagoras thought of violets as spinach.

Begonia, Wax Plant

Begonia semperflorens

Height to 18 in. Stem above ground soft, not much branched, green or reddish. Leaves to 4 in. long, nearly oval, oblique at base, with toothed margins, a large stipule at base, with hairs between teeth in leaf margin. Roots relatively fine and fibrous.

Native of Brazil. Such varieties as Chatelaine, Henry Martin, Vernon, Carrierei, and Erdfordii have been evolved from this species. Group is commonly known as the ever-blooming begonias in contrast with the rex begonias, the tuberous-rooted begonias, and the fibrous-rooted begonias.

Flowers rose-red to pink or sometimes white, on few-flowered clusters arising from leaf axils, not conspicuously drooping. Pistillate flowers have 2 sepals and 2 petals, while staminate have the same number but narrower petals. Stamens, many, yellow. Pistil 2-3-celled, with wings and a twisted stigma.

Cuttings may be started in spring or old plants may be reported in summer if it is desired that they be grown indoors for more than a year. They do best at temperatures between 60-70°F. in soil with a moderate amount of water but with good drainage. They need good light but little direct sun.

A popular house plant commonly reproduced by cuttings of almost any vegetative part but more particularly stems or leaves since these root easily and quickly establish their independence. Soil to be at best should be porous and well-mixed with sand and leaf mold.

Family Begoniaceae

Rex Begonia

Begonia rex

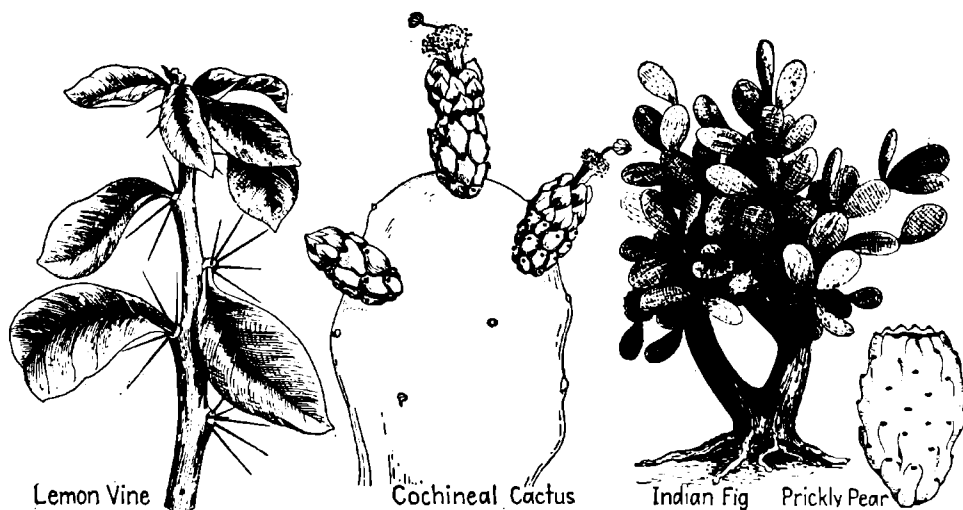
No upright stem. Rootstock lies more or less horizontally near surface of ground and bears coarse attractive leaves. Leaves to 1 ft. or more long with blade held perpendicularly, from long hairy succulent petiole, red beneath, silvery and green above or varicolored but usually conspicuous.

Native of Assam. Common cultivated varieties are probably *B. rex-cultorum* derived from many variations of *B. rex*. This is really a group of begonias, most of which are at their best when grown indoors or in the shade if not in their native land.

Flowers few, in loose clusters that reach above leaves, pale rose or pink, with 2 sepals that are color of petals but narrower in staminate flowers. Petals in staminate flower, 2; in pistillate, 2 or more of the same size. Fruit 2-3-celled, with wings and a twisted stigma.

Requires moderate sunshine, favoring the morning sun. Does best at a temperature of 60-70°F. with a moderate amount of water applied to roots rather than to leaves. Can be reproduced easily by cutting a leaf in half and sticking the leaf vertically in moist sand.

Planted outdoors, rex begonias do best in quiet, sheltered spots where there is a rich leaf mold. This is essentially a foliage house plant. Red spiders, mites, thrips, aphids, mealy bugs, and nematodes attack begonias not adequately cared for, many of which are encouraged if the leaves become too wet.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Opuntiales. Family Cactaceae

Lemon Vine, Leaf Cactus
Pereskia aculeata

Shrub that becomes a vine, with climbing woody stems. Stems to 30 ft. long and branching. Related *P. grandifolia* a shrub or tree but not a vine. Spines on lower part of stem, 1, 2, or 3 in a group, slender and straight; axillary spines, usually in 2's and recurved. Leaves to 3 in. long, short-petioled.

Widely established in tropical America. Normal range through West Indies, on east and north coasts of South America, and also grown in Florida and Mexico. Plants in Washington and New York greenhouses bloom rather regularly. Not grown more commonly as an ornamental largely because of its offensive odor.

Flowers white, showy, fragrant, sometimes pale yellow or pinkish, to 1½ in. across in small clusters. Stamens numerous. Lower part of the pistil with scale, leaves or spines on it. Fruit light yellow like a lemon, to ¾ in. in diameter; when mature, smooth and juicy. Seeds black and somewhat flattened.

Species has been in cultivation in Kew Gardens, England, since 1760; and in other places longer. In Argentina it is called *sacharosa* but this is not a correct use of this common name. Also known as Barbados gooseberry and West Indian gooseberry. Flowers fragrant but odor of vegetation is most offensive to some persons.

Cultivated in some parts of the world for fruits, which have market value, grown as hedge plant and as cover for walls and for some kinds of buildings. Related *P. grandifolia* common in greenhouse collections and can be distinguished by solitary straight spines on young growth in place of recurved pairs.

Cochineal Cactus
Nopalea cochinellifera

Height to 12 ft. Trunk diameter to 8 in. Branches spreading or ascending, with oblong joints, spineless, or the older ones with minute spines; bright green, particularly when young. Leaves small, awl-shaped, and falling off early. Spine clusters bear many small spines and an occasional larger one.

Original home territory not known but is found widely scattered in tropical and semitropical countries where it was cultivated. Spaniards found it under cultivation by Mexicans in 1518 and transplanted stock to Spain, whence it spread to India, Africa, the Canary Islands, and elsewhere.

Flowers usually abundant, appearing from tops of joints, about 2½ in. long, with scarlet petals and sepals, the petals being somewhat longer. Stamens pinkish, many and extending about ½ in. beyond the petals and sepals. Fruit red, about 2 in. long, rarely maturing under ordinary cultivation as in greenhouses.

Plants are set in rows about 4 ft. apart. Minute cochineal insects, *Dactylopius coccus* are placed on the joints or branches, where they multiply, and in about 4 months are collected by brushing off into bags. 2-3 collections may be made in a year. Cochineal is a scarlet, brilliant dye, now mostly supplanted by aniline dyes.

Small cochineal insects killed by heat from stoves give the natural silver-gray cochineal, while those killed by hot water provide what is called black cochineal. At one time (1868) the Canary Islands produced and exported annually to England some 6 million lb. of cochineal worth 4 million dollars. Insect origin discovered 1703.

Indian Fig, Prickly Pear
Opuntia ficus-indica

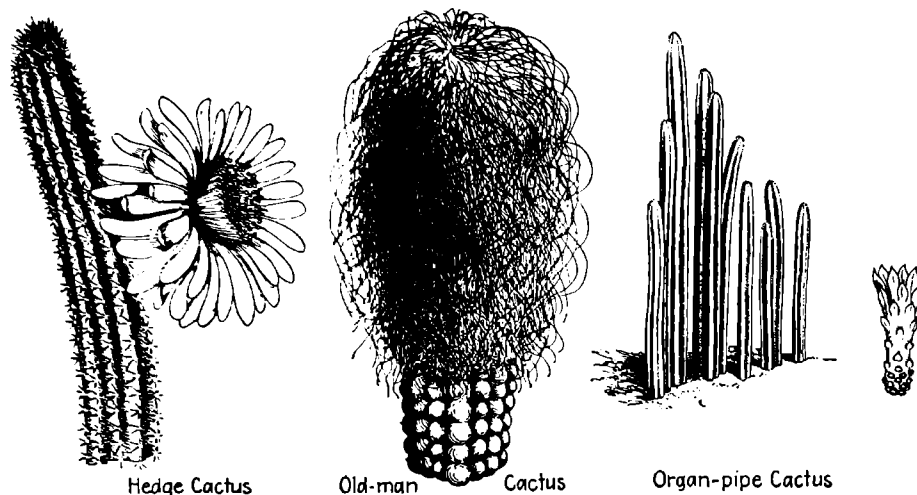
Tree or bush. Height to 15 ft. or even more. Stem jointed, with units to 15 in. long, oblong or elliptic, thickened, usually spineless, and with a bluish bloom over otherwise smooth surface. Main trunk woody, rather cylindrical. Leaves drop off early and are very short.

Native of Mexico (?) but widely grown in warmer parts of world. Sometimes maintained under cultivation and sometimes escaped and established as somewhat troublesome weed. Over 250 species of *Opuntia*, all native of America; about 90 in western United States. *O. compressa* ranges from Massachusetts to Florida and west to Kentucky.

Flowers yellow, to 4 in. across, with showy corolla and calyx blending apparently one into the other, with little difference between sepals and petals. Stamens much shorter than petals. Fruit over 3 in. long, red, edible, somewhat top-shaped, bristly, reddish-fleshed.

Forms free from prickles are grown as stock food and introduced from the Mediterranean area. Joints are broken and planted in well-drained, light soil 8 ft. apart in furrows 12 ft. apart. These begin bearing in 3 years and bear regularly thereafter.

Fine bristles that cover the fruit can be removed by rubbing with a leaf or cloth. Earlier varieties mature in June and the later in November. To prepare fruit for eating, remove thin slices from each end, slit the skin from end to end, and unwarmp the peel from the edible pulp inside.



Hedge Cactus

Old-man

Cactus

Organ-pipe Cactus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Opuntiales. Family Cactaceae

Hedge Cactus

Cereus peruvianus

Tree-like or somewhat sprawling, to a height of 50 ft. Branches green, to 8 in. in diameter, sometimes smooth, with to 9 longitudinal ribs bearing clusters of 5-10 sharp brown to black spines, each to 1½ in. long. Night-blooming cactus. *Hylcereus* is a climber, with 3 ribs and spine clusters of to 3 small spines.

Native of southeastern South America, but widely planted and adjusted to existence in tropical America and other tropical parts of the world, and grown in greenhouses in temperate regions. Over 100 species of *Cereus*, all native of South America, though some are now considered as belonging to different genera.

Flowers about 6 in. long, white, with a thick tube, particularly abundant on lower part of stem, superficially like a water lily except that they open at night instead of in bright sunlight. Fruit globular, slightly fuzzy, about 1½ in. in diameter with black rough seeds; inside fleshy and orange-yellow.

When grown in house or in greenhouse, care should be taken to provide suitable soil conditions and to place plant where temperature conditions are appropriate. These call for good drainage, an average temperature of around 70°F., and a soil that is not too rich, such as can be attained by mixing sand and garden soil.

The fruits of many members of the genus are edible, but great use for plant is as a hedge and for its beautiful flowers, in spite of fact that these are only about ½ as wide as flowers of *Hylcereus*. Some species of genus are sprawling vine-like climbers while others are prostrate.

Old-man Cactus

Cephalocereus senilis

Erect columns, usually unbranched and rising to a height of over 5 ft., with trunk diameter to 1 ft. Branching, if present, is more likely at top but may rarely be at base. Ribs 20-30, of large wart-like units, with a head of long gray bristles and with basal spines to 1 ft. long.

Native of Mexico, where it is found wild in Hidalgo and Guanajuato, particularly on the limestone hills of eastern Hidalgo where it may be the most conspicuous plant on the landscape. At least 48 species recognized in the genus, but this is probably the best known and most widely distributed.

Flowers numerous, to 4 in. long, red outside and rose within, with the tube bearing few scales. Fruit egg-shaped, to 2 in. long, bearing at the top the base of the flower which has a few scales and hairs still attached. Seeds black.

Young plants covered with long, white silky hairs, giving the plant its name. Large plants rarely seen, though small plants are one of popular cactuses for house plants. Little wood tissue, and largest may be cut down with a pen-knife with ease.

Great quantities of the small plants have been shipped to Europe and to other parts of the world for sale to cactus hobbyists. Bases of old plants have weak gray bristles that are 1 ft. long, but such plants are not often seen except in the native areas.

Organ-pipe Cactus

Pachycereus marginatus

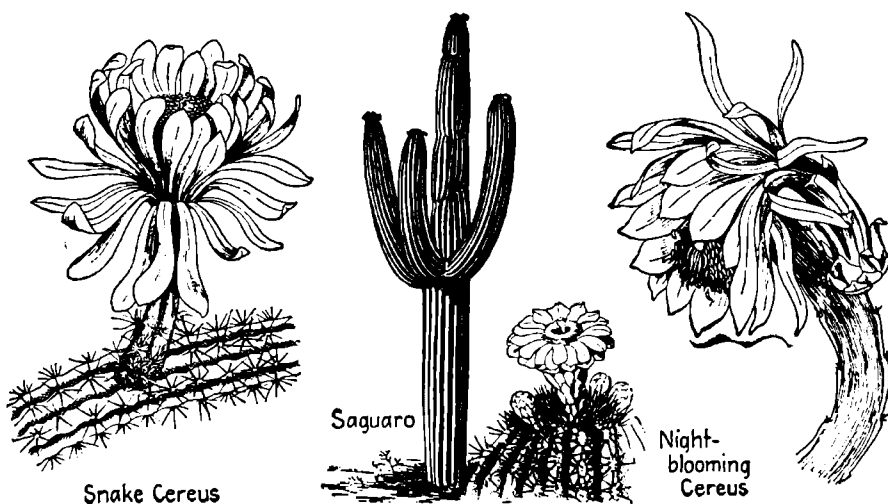
Height to 25 ft. Stems usually erect and unbranched. Ribs 5-6, usually sharper in the younger plants and much blunted with age. Spine clusters closely crowded, their wool forming a dense cushion along ridge of each rib. Spines 5-8 in a cluster, with the center one conspicuous.

Native of Mexico and found wild in Hidalgo, Queretaro, and Guanajuato. Widely established in Mexico, Jamaica, Cuba, and similar areas, where it is grown deliberately or occurs as an escape from cultivation. At least 10 species of the genus recognized, all native of Mexico or of southern California.

Flowers funnel-shaped, to under 1 in. long, including the supporting ovary. Tube and ovary rough and scaly, often with bunches of wool and small spines at edge of scales. Fruit globular, over 1 in. in diameter, covered with wool and spines that drop off at maturity, not particularly fleshy. Seeds numerous, black and shining.

Figures in lore of areas in which it grows, in part because it usually separates native dwellings. Properly cared for, it can provide an impenetrable hedge that is not unattractive; because of its spines, it is an effective barrier even though there are apparent openings at intervals.

Around estates and the lands of the poor, this plant takes the place of the old stump fence or stone wall in rural northeastern United States or of the wire fence of today. It has a type of beauty not possessed by any of these devices. In its native area, it is sometimes called "organo" in reference, of course, to the organ-pipe-like stems.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Opuntiales. Family Cactaceae

Snake Cereus
Nycotereus serpentinus

Stems grow in clusters that are at first erect but eventually clamber or hang and reach a length of nearly 10 ft., with a diameter of not over 2 in. Ribs 10-13, low and rounded. Small areas on surface crowded, felted, with sharp or bristle-like spines that are to 1 in. long. Tips of spines usually darker than remainder.

Native of Mexico, probably from near the eastern coast. Not now known from the wild state but is widely cultivated and has escaped from cultivation in areas. About 5 species of the genus supposedly native of Mexico and Central America, of which this species is most widely cultivated.

Flowers borne at upper ends, sometimes literally terminal, white, to 7 in. long and to 3 in. wide, with tube and support exceptionally bristly, funnel-shaped. Pistil and stamens of about same length. Fruit red, covered with spines that drop off easily, to 1½ in. long. Seeds black, rather large for such a small cactus fruit.

Known as night-blooming cereus, as are a number of other cactuses here considered. May be propagated by making cuttings from new growing areas. These plants can make an old rock pile attractive since they climb in and over the units and eventually burst into bloom at night. It is known in Mexico as "junco" or "junco espinosa."

The scientific name, of course, means night cereus and because of this might claim for the genus priority on the common name night-blooming cereus. However, its common name snake cereus is even more appropriate and probably is the name by which it is known by most persons.

Saguaro
Carnegiea gigantea

Height to 40 ft. Composed of erect cylindrical columns to 2 ft. in diameter and unbranched, or up to 12 branches, the branches parallel to main trunk. With to 24 vertical ribs, each blunt and to over 1 in. high. Spines of 2 kinds, those above being yellow-brown, the lower ones stouter and to 3 in. long.

Found in Arizona, southeastern California, and Sonora, Mexico. Known to science since 1848. Some related Mexican species in other genera are larger and would weigh more; of these, *Lemaireocereus webberi* is considerably taller and stouter. J. O. Pattee, who saw it in 1825, was first Anglo-Saxon to see this plant.

Flowers to about 4 in. long and sometimes as broad as they are long, supported by a green-scaled, white-felted tube about ¾ in. long and about 1 in. wide at the throat. Stamens white (one flower had 3,482). Pistil white or cream-colored, to over 2 in. long. Fruit a red or purple, edible, 2-3 by 1-in. berry, with to 2,000 seeds.

Fruits eaten by Indians. In a national monument of 2,000 acres of desert land 20 miles east of Tucson, Ariz., on a rocky hillside, these plants will be forever protected. Largest individuals are considered to be 200 years old. Plants 4 in. high are 10 years old; 3 ft., 30 years; after that they grow 4 in. a year.

Primitive peoples used heavy rods from stems for building construction; fruits and seeds, for food and drink. In wet seasons, plant may be 98% water, most of which is lost in May and June. Woodpeckers burrow into the trunks and pygmy owls nest in abandoned woodpecker holes. Wounds in rainy season may become badly infected with bacteria.

Night-blooming Cereus
Heliocereus undulatus

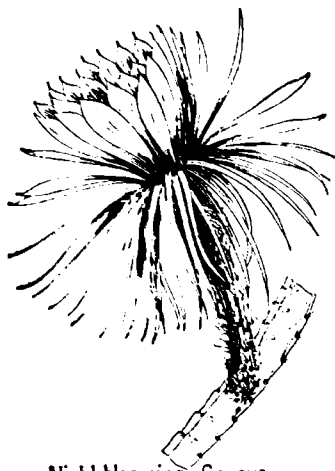
Climbing. Stems adhere to walls, trees, and similar supports by aerial roots, often to 40 ft. long, green, with 3 ribs, thin and with a horny margin. Spines short but effective, arranged in groups about 1½ in. apart and with 1-4 spines to a group. Whole plant may twist and wind around its support and branch freely.

Native of Mexico but established in the tropics and subtropics generally as an ornamental and in greenhouses the world over as an interesting decorative plant. Listed in literature as *H. tricosatus* and as *H. triangularis*. Other genera considered popularly as cereus are *Selenicereus*, *Aporocactus*, and *Echinocereus*.

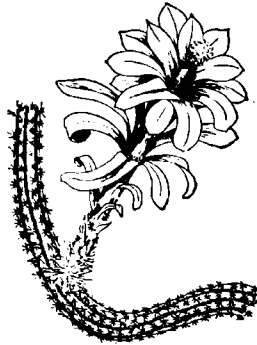
Flowers about 1 ft. long, with yellowish-green outer segments turning backward and numerous center ones erect. Abundant stamens are cream-colored. Whole flower looks like an enormous white water lily superficially and is fully as fragrant. Fruit red, scaly, except when young when it is smooth, edible, oblong, to 4½ in. through.

Flowers appear at night remaining open until dawn. May be picked and kept open in an icebox for some time. It flowers in homes and greenhouses as far north as New York. Of the 16 species of the genus, the one here listed is undoubtedly the most popular as an ornamental or as a wall cover.

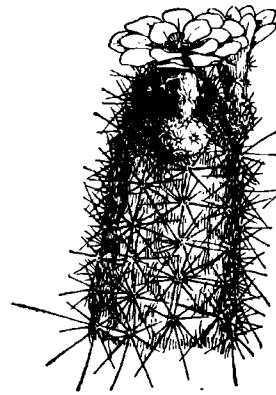
One is fortunate indeed who has the opportunity to observe a hedge of this plant in full bloom. Commercial reproduction is largely by cuttings and rooting the slips in sand.



Night-blooming Cereus



Rat-tailed Cactus



Hedge-hog Cactus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Opuntiales. Family Cactaceae

Night-blooming Cereus

Scientereus pteranthus

Trailing or climbing plants but relatively stout, with stems to 1½ in. or more in diameter. Stems blue-green to purple, conspicuously 4-6-angled, with ribs on younger branches to ½ in. high. Spines in clusters 1-4, short, dark, rarely over ½ in. long but most effective.

Native of Mexico but known mostly from conservatories, where it has long been a popular species. Probably commonest of conservatory-grown night-blooming cereus plants. 16 species in the genus, ranging from southern Texas to South America, one extending down to the Argentine.

Flowers to 1 ft. long and 15 in. across, white, very fragrant, the tube and throat about half the length of flower and swollen in upper part. Lower cluster of stamens attached to petal tube for about 3 in. Fruit red, globular, about 2½ in. in diameter, covered with long white silky hairs or bristles.

Flowers open in night and produce remarkable effect because of their beauty and fragrance. Some species are reported to have medicinal value, but beauty and fragrance of flowers should have a therapeutic effect on most confirmed of pessimists. Not surprising that flowering time is announced in newspapers.

A plant that can be grown in a 10-in. pot and produce flowers that may be 15 in. across is bound to hold interest of almost anyone. Related *S. grandiflorus* yields a heart tonic extracted from the green branches and originally discovered in Naples in 1889. The medicinal agent is probably an alkaloid.

Rattail Cactus

Aporocactus flagelliformis

Slender, vine-like creeper that twists and turns over its supporting tree or wall or sometimes hangs suspended from such a support. Stems weak and rarely over ¾ in. in diameter, with 10-12 low inconspicuous, somewhat warty ridges and well-supplied with clusters of many brown spines. Has aerial roots.

Native of Mexico and Central and South America. Reported to have been found growing wild on trees on the coast of Jamaica but has not been known wild from that island in recent times. Best known in temperate regions from greenhouses and sometimes as a house plant. 5 species of the genus.

Flowers to 3 in. long, pink to crimson, with outer segments more or less bent backward, the inner spreading only slightly, and all these parts relatively narrow. Stamens in somewhat of a tube terminated by the yellow anthers. Fruit to ½ in. through, red, bristly, globular, with yellow pulp.

Flowers remain open or go through opening process for 3-4 days. In Mexico, the dried flowers are sold as a household remedy under the name of "flor de cuerno," and this is sometimes found in drug markets under the same name. A common window plant in Mexico.

Apparently was introduced into Mexico from Peru about 1690, but it is not known in a wild state anywhere at present time. Mexicans frequently plant it in the open end of a cow's horn and hang this on the outside of the house. Flowers from mid-December to mid-January. Easily grown.

Hedgehog Cactus

Echinocereus polyacanthus

Height a few inches, 5-in. plants bearing flowers. Stems cylindrical but narrower toward top, making whole thing somewhat like a typical plump cucumber. Stems often grouped to make a mass. Ribs 9-13. Radial spines stout, 8-12, lower one longest, being to about 1 in. long; upper, ½ in. white to red and dark-tipped.

Found native from Chihuahua and Durango in Mexico to western New Mexico and southeastern Arizona. Described in 1848 by Engelm., but confused in its classification for some years. Now found rather commonly in cactus collections together with the purple-flowered *E. pectinatus*, the true hedgehog cactus *E. engelmanni*, and the rainbow cactus *E. rigidissimus*.

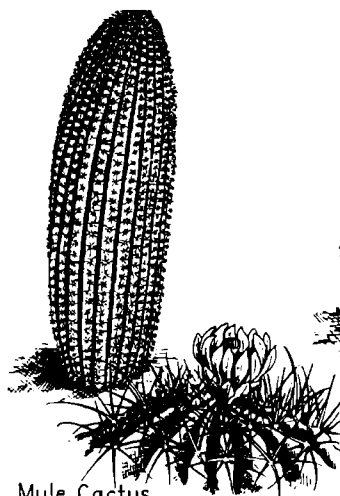
Flowers scarlet to salmon, 2½ in. long, lateral but held erect, with a funnel-shaped base and widespread showy parts. Flower tube yellow; spines on flower base are well intermixed with a cobweb-like wool. Fruit spherical, about 1 in. long, spiny, greenish-red, uncommon. Some authors claim fruit is unknown.

Fruits of some of members of genus are edible, spines that cover them being easily removed when fruits have become mature and skin is unusually thin. Seeds black and bear small tubercles in most members of genus. Some 60 species known in genus of which nearly ½ are grown as ornamentals.

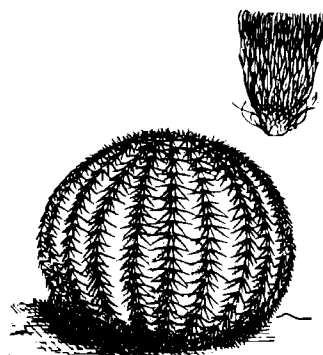
Some members of the genus have sprawling stems. In this species the small scarlet flowers separate it from many of other common species whose flowers are crimson or purple but not scarlet. In *E. pectinatus* there are several central spines in spine group; in *E. rigidissimus* there are none.



Mescal Buttons



Mule Cactus



Golden Cactus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Opuntiales. Family Cactaceae

Mescal Buttons

Lophophora williamsii

Globular. To 3 in. in diameter, arising from a coarse taproot extending to a depth of 4 in. or more. Ribs 6-13, nearly vertical or irregular and indistinct and composed of a series of tubercles each of which is crowned with a delicate bunch of spines; dull bluish-green.

Found from central Mexico through southern Texas. Looks so much like mushroom that it has been considered to be one by some, and bears common name of "sacred mushroom" as well as a host of other names. There seems to be only 1 species in spite of fact that some writers consider there are 2.

Flowers found at top of plant, white, to 1 in. across when fully opened, surrounded by a mass of relatively long hairs, the outer flower parts being greenish on the back and somewhat swollen at the tips. Stamens and pistil much shorter than surrounding parts. Fruit under 1 in. long, naked, pink. Seeds black.

Yields the narcotic anhalonin, although the narcotic effect may be caused by resins. Drug causes persons using it, in drinks or otherwise, to lose all sense of time, as does hasheesh from *Cannabis indica*. Drug users also have remarkable visions. Its use dates to pre-Columbian times and is forbidden by law.

Indians used the plant in "breaking fevers" and in religious rites. Plants are cut and dried to make "mescal buttons." Indian names include xicori, pellote, peyote, peyoti, hiculi, camaba, seni, huatari. A spree with the drink is followed by a long period of wakefulness.

Mule Cactus

Ferocactus wislizeni

Height: to over 6 ft. At first almost spherical but when mature forms a cylinder. Usually unbranched but if injured may bear several heads or branches. Ribs to 25 or more, about 1 in. high. Spine groups with one central strongly hooked spine surrounded by many smaller ones and by brown felty areas.

Found growing wild from El Paso, Tex., through southern New Mexico and Chihuahua to Arizona and Sonora, and possibly on to Lower California. Reported, probably erroneously, as from Utah. Some 30 species of the genus, all globular or cylindrical and all with well-developed straight or hooked spines.

Flowers to 2½ in. long, yellow, supported by green-scaled tubular base. Some flowers may be reddish or orange, borne only on younger growth just above spine clusters. Stamens very numerous, borne in throat of flower and much shorter than showy parts of flower. Fruit to 1½ in. long, yellow, oblong. Seeds dull black.

Grown as an ornamental to some extent. Related *F. glaucescens* is smaller and has no curved spines. Usually, picture showing a Mexican drinking water from a "barrel cactus" represents a plant of this genus. Doubtful if the plants can be considered a source of water except in case of dire need.

While the interior may consist of a moist pulp, it is not filled with clear cool water, as some publicity agents would have us believe. Plants have a unique beauty that should justify their continued protection. Small plants are grown indoors by hobbyists quite commonly. *F. acanthodes* is the barrel cactus, and *F. johnsonii* the devil's big toe.

Golden Cactus

Echinocactus grusonii

Large balls. Sometimes to nearly 1 yd. in diameter, unbranched. Ribs from 21-37, thin and high. Spines vary in color from golden-yellow when young to pale or even white, and finally to dirty brown; with the radial spines to over 1 in. long and the usually 4 central spines up to 2 in. long. Plants usually grow singly.

Native of Mexico and is found wild from San Luis Potosi to Hidalgo. A popular plant in collections maintained by hobbyists and by greenhouse operators. Genus has at least 9 species, of which this is probably best known. Other species lack the bright yellow spines that give the group its common name and its popularity.

Flowers red and yellow, borne at the top and center, to 2½ in. long and opening fully only in bright sunlight. Stamens yellow, numerous, forming a cylinder. Pistil yellow, divided at the top into 12 lobes. Fruits spherical, bearing pointed scales, with an abundance of wool in their axils, to ¾ in. long. Seeds blackish, smooth and shining.

Woolly crown; woolly, thin-skinned fruit and smooth seeds are characteristic of the genus; the golden spines, of the species. Large specimens are not commonly seen. Plants may bloom at 6-month intervals through the year, beginning about mid-May. Flowers will open in 3 days under good conditions.

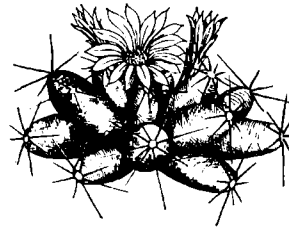
New plants are obtained from seeds, or a large plant is cut off at top, stimulating development of buds that are removed and started as new plants. Flowers sunken rather deeply in stem and surrounded by felt cushion so that to be collected they must be actually dug out of surrounding tissue.



Orchid Cactus



Christmas Cactus



Pin-cushion Cactus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Opuntiales. Family Cactaceae

Orchid Cactus

Epiphyllum ackermannii

Stems many, to over 3 ft. long, somewhat recurved, with branches that are for most part under 1 ft. long, unarmed, with middle and side ribs, with short bristles on younger and lower portions. The flat 2-edged branches have waved or shallow-toothed margins as in some leaves of other plants.

This is not known in wild state, though most other members of genus come from Mexico, Central America, and northern South America. By some writers, this is considered a hybrid and not a natural species. It was originally described from material sent by Ackerman from Mexico. It may represent *Epiphyllum* and *Helicocereus*.

Flowers to 6 in. across, blooming in the daytime, flaming red or scarlet outside and carmen within, with a greenish-yellow throat and very short tube. Tip of pistil, pink. Flowers closely resemble those of *Helicocereus*. Lower part of pistil is more or less bristly.

Culture of plant is usually by cuttings and rooting of the sections in suitable earth. Some prefer to cover the young shoots with glass until they get a start, and borders with the base broken off may serve this purpose well.

One of at least a half-dozen genera that have long been popular as house plants and in warmer parts of the country as outdoor ornamentals. Name means "on leaf" and no doubt refers to the fact that the flowers appear on what seems to be the leaf, though it is really the stem.

Christmas Cactus

Zygocactus truncatus

Plant hangs in large bunches from trees and similar supports. Stem flat, with joints 1-2 in. long and $\frac{3}{4}$ -1 in. wide, thick, green, soft, blunt at tip of each joint; with upper part of each joint more or less curved inward like a blunt horn. Whole stem relatively weak and somewhat succulent.

Native of Brazil. Many of cultivated forms found in houses and greenhouses are hybrids of different species of the genus, or hybrids of these with forms of *Cereus* or of *Epiphyllum*, the last of which is normally found growing on trees as does typical Christmas cactus.

Flowers solitary, growing from ends of young joints, showy, magenta red, $2\frac{1}{2}$ -3 in. long, with calyx and corolla alike and composed of many curled-back segments. Stamens many, with long pink filaments. Fruit pear-shaped, red, to nearly $\frac{1}{2}$ in. in diameter.

Flowering time late winter. Commonly reproduced by stem cuttings. Ideal soil about $\frac{2}{3}$ garden soil and $\frac{1}{3}$ sand, with good drainage. Should be placed in a sunny window where it will not be disturbed, provided with water sparingly except at blooming time, and kept at temperature between 60-70°F. to be at best.

After house plant has bloomed, water should be withheld for some time. Plant should be kept in same pot for years without changing. Plant responds to treatment and unless used sensibly may be disappointing instead of an outstanding delight.

Pincushion Cactus

Mammillaria longimamma

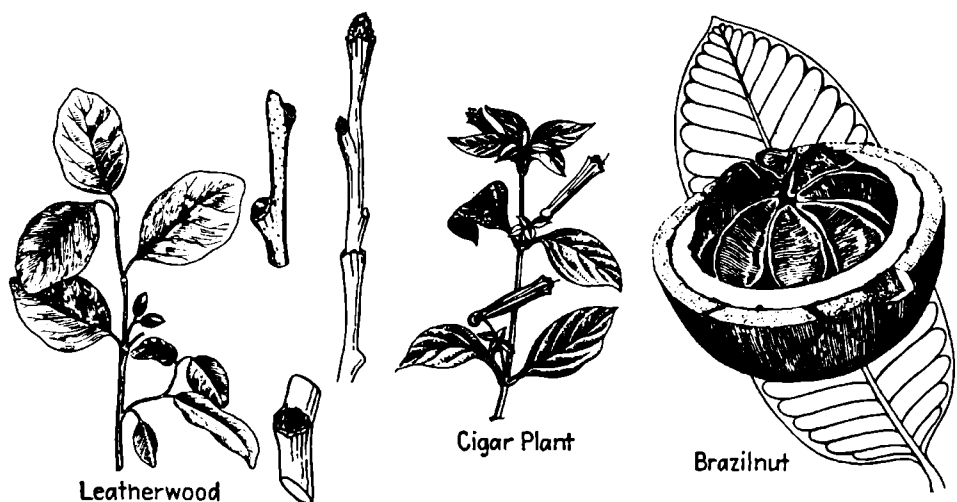
Form rather large clumps of tubercle-like structures, each to about 2 in. long and terminated by a circle of about 6-12 spines, each about 1 in. long, with whitish hairs when young but naked with age. Spines arranged like spokes of a wheel and sharp, white or pale yellow. Whole plant takes a general dome shape.

Native of central Mexico. Cultivated to some extent for unique ornamental qualities. At least 150 species known, of which nearly $\frac{1}{4}$ are considered of importance as ornamentals by hobbyists.

Flowers lemon-yellow, with many pointed petal-like parts surrounding shorter stamens and pistils that are crowded to center. Whole flower to over 2 in. across, borne in the woolly axils between the tubercles. Fruit nearly smooth and berry-like.

These bright green spiny cushions are relatively common in greenhouses. In the southern part of the United States, may be grown outdoors where soil conditions are suitable. Some species of the genus may be found in flower from March through November.

Species commonly grown for flowers include *M. albicans*, *M. bocasana*, *M. camptotricha*, *M. elegans*, *M. elongata*, *M. habniana*, *M. hemisphaerica*, *M. microbelia*, *M. parkinsonii*, *M. parbella*, *M. rhodantha*, and *M. trichacantha*. *M. macdougalii* known as pincushion cactus, *M. fragillilis* as thimble cactus, *M. dioica* as candy cactus, and *M. plumosa* as feather bed cactus.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Myrtales

Family Thymelaceae

Leatherwood *Dirca palustris*

Shrub to 6 ft. high. Twigs conspicuously jointed, smooth, somewhat yellowish-green to very dark. Leaves egg-shaped, entire, rounded at base, somewhat pointed at tip, to 3 in. long, fuzzy when young but smooth when mature. Bud scales with brown hairs that drop off, 3-4 showing. General shape of shrub almost globular if in open.

Found in damp rich woodlands or sometimes in the open but usually only where there is good wet soil. Ranges from New Brunswick to Florida and west to Minnesota, Missouri, and Tennessee. Sometimes grown as ornamental but not a superior plant for that purpose. 2 species in the genus and over 400 in the family.

Flowers develop just before leaves and apparently surrounded by newly developing leaves, yellow, under $\frac{1}{2}$ in. long, with pistil longer than the 8 stamens borne on the corolla. Every other stamen longer than its neighbors. Fruit fleshy, with a stone center, to $\frac{1}{2}$ in. long, reddish, appearing in summer.

Bark contains substances that can cause severe blisters and irritations to skin of some persons. Taken internally, bark can cause severe vomiting. In this connection it has some medicinal uses. Berries reported to have narcotic property. Seeds sown in fall or spring. Plant remarkably free of insect and fungous pests.

Moose and deer sometimes use it as forage. Wood not at all leathery as name implies but bark is exceptionally tough. Indians and pioneers used it as an emergency fiber for thongs and other cordage. Sometimes found being used as an ornamental. Worthy of such recognition. Known also as wicopy, wickup, and leatherbark.

Family Lythraceae

Cigar Flower *Cuphea platycentra*

Stem much-branched, slender, smooth, often red on one side, soft. Leaves abundant, to $1\frac{1}{2}$ in. long and $\frac{3}{4}$ in. wide, sharply pointed at free end, nearly smooth, entire, opposite, narrowed at base into a distinct petiole, slightly scaly. Root system fibrous.

Native of Mexico, now rather well-established as a popular house plant that is usually most attractive in mid-winter. Over 200 species of the genus, some being herbs like this species, others shrubs. Some are hardy enough to survive outdoors in southern United States.

Flowers solitary, red, cigar-shaped, borne in leaf-axils and hung on a slender stem, spurred. Calyx tube about 1 in. long, flaring at end, 6-pointed, red, with a dark ring around it at end. No corolla. Stamens 11, inserted near end of calyx tube. Fruit long and slender, $\frac{3}{4}$ in. long, backward-spurred.

Commonly propagated by stem cuttings started in summer in soil and kept in shade for at least 1 week. Favors abundance of sun, in soil composed of $\frac{3}{4}$ garden soil and $\frac{1}{4}$ well-rotted manure, at temperature between 60-70°F. Requires an abundance of moisture.

Plant useful apparently only as an ornamental. Has few fungous or insect enemies. May be grown from seeds but cuttings may shorten time to maturity.

Family Lecythidaceae

Brazil Nut, Niggertoe *Bertholletia excelsa*

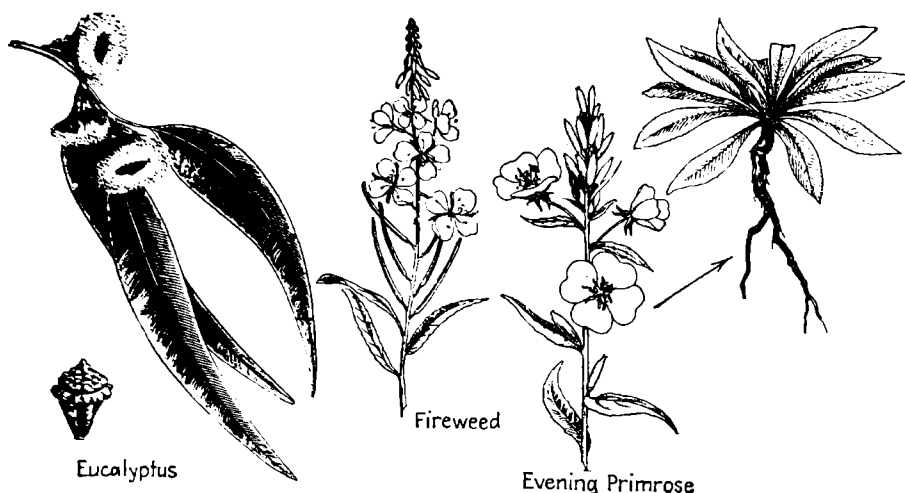
Tree. Height to over 150 ft. Trunk to over 4 ft. in diameter. Bark smooth. Branches high. Leaves alternate, to over 2 ft. long and about 6 in. wide, leathery, bright green, with wavy margins, somewhat oblong. The tall tree is rather conspicuous for way in which it branches most abundantly near top.

Native of Brazil where it is found in great forests largely along banks of Amazon and the Rio Negro. Not grown in open anywhere in United States but its nuts are known in practically every home in America. Some 18 genera and 230 species in family in South America, western Africa, and Malaya.

Flowers cream-colored, with calyx parts united but tearing into 2 parts when flower opens, these two parts dropping off; borne in open clusters. Petals, 6. Stamens, many, united, uppermost without anthers. Fruit about 6 in. across, with hard thick shell, containing 18-24 hard, 3-sided nuts.

Tree not hardy enough to survive outdoors in United States and not attractive enough for growth as an ornamental anywhere. Oil extracted from meats by pressure; finds various uses particularly by artists and watchmakers. Bark used in calking ships particularly at Para, Brazil.

Common trade name of castana describes the nuts of a number of species of the genus. Chief point of exportation is Para. Natives collect fruits and break them to free the nuts. United States normally imports from 20-30 million lb. a year. Known as monkey-pots in some places.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Myrtales

Family Myrtaceae

Eucalyptus, Blue Gum

Eucalyptus globulus

Tree. Height to over 300 ft. Bark peels off in great longitudinal strips or hangs swinging, leaving trunk smooth and bluish-gray. Leaves opposite, on young shoots, thick and leathery, pointed at end, to 1 ft. long, often somewhat whitened, with a mealy covering, relatively broad.

Native of Australia. Naturalized in California where it is a common street tree and is grown for various purposes. Over 300 species coming from Australia and Malayan region. Many of these have been adapted to cultivation in the warmer temperate regions of the world. 14 species were introduced into California in 1856.

Flowers large, to 1½ in. across, solitary or in groups of not over 3. Calyx tube hard, warty, with a blue-white wax covering with the lid in the center, shorter than tube itself. Fruit stalks flattened. Fruit, a capsule with lid made of united calyx and corolla. Stamens, many. Flowering time from December through May.

Wood easily stained, not durable in contact with soil, checks badly in logs when being cured, strong, rapidly growing. Tree endures minimum temperature of 25°F. and high temperatures but young trees cannot resist drought well. Flowers yield much nectar and attract honeybees but the honey is not popular because of its flavor.

Oil distilled from leaves of *E. globulus* and *E. dives* is used in treating colds, malaria, and other fevers. Imported timber trees are karri, *E. diversicolor*, and tarrah, *E. marginata*. Mallet bark, *E. occidentalis*, yields to 50% tannin. Gum kino, used in medicine, comes from *E. rostrata*. Trees use much water and reduce mosquito hazard.

Fireweed

Evening Primrose

Fireweed

Epilobium angustifolium

Herb. Height to 8 ft. Stem stout, smooth, or sometimes finely downy, branched or unbranched, erect. Leaves alternate, short-petioled, to 6 in. long and to 1 in. wide, dark-green above and pale green beneath, narrowed at each end, pointed, ends of cross veins not coming to edge of leaf but joining next vein forward.

Native of Eurasia but thoroughly established in America from Greenland to North Carolina and west to California and Alaska. Found in Rocky Mountains south into Arizona. Usually most abundant in burned-over areas either in low ground or in the mountains. About 80 species in the genus, some 400 in the family; widely distributed.

Flowers showy, to 1½ in. across, usually purple but sometimes white, in long terminal spike-like clusters, with lower ones appearing longer. Petals, 4, entire, broad. Sepals, 4, narrow. Stamens, 8, shorter than pistil. Fruit a capsule to 3 in. long, slender, breaking to free whitish plumed seeds.

Flowers in June, July, and August. Bears fruits and seeds through August and September. Flowers give a hill-side the appearance of being in flame; seeds, the appearance of a great cloud of smoke. Lower flowers mature first so sometimes a plant may bear both flowers and seeds at same time.

Plant well known, as is indicated by many common names such as purple rocket, Persian willow, rosebay, French willow herb, bay willow herb, firetop, spied willow herb, great willow herb, Indian wickup, blooming sally, blooming willow, flowering willow, and herb wickopy. Shoots eaten like asparagus; leaves, as tea; and pith, in soup.

Evening Primrose

Oenothera biennis

Herb. Height to over 6 ft. Branched or only slightly so, erect, rather coarse, rough or more rarely smooth, biennial. Leaves alternate, to 6 in. long and to 1½ in. wide, pointed at tip with clasping base; margins obscurely, shallowly, and sparingly notched. Lowest leaves may be with short petioles.

Native of America. Found on dry soil and in waste places from Labrador to Florida, west to Minnesota and Texas with closely related species extending range to Pacific Coast, with other closely related species in the Old World. Related *O. lamarkiana* has been grown as an ornamental in European gardens for over 100 years.

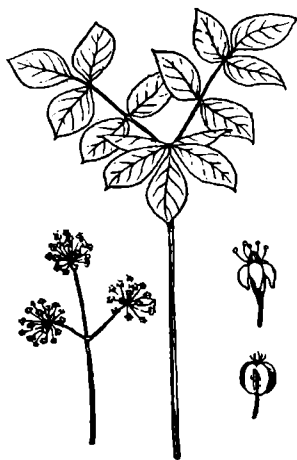
Flowers open at dusk, to 2½ in. broad, clean pale yellow, with an elongate tube at base. Sepals, 4. Petals, 4, broad and spreading. Stamens, 8, of equal length, about length of pistil. Fruit a capsule that opens at top to free small brown seeds, to 1½ in. long and to ¼ in. thick.

Under short days of winter plant forms a rosette; under constant illumination it grows into a tall plant. Under normal conditions, it forms a rosette first season and tall flowering stalk second. Rosette characterized by pinkish cast to light-colored veins. DeVries used *O. lamarkiana* in developing his mutation theory of evolution.

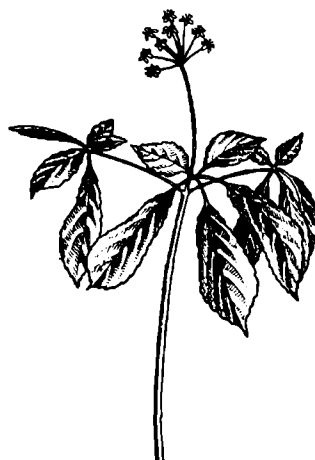
Roots of the rosette in spring used as salad or cooked, but it must be collected early or it will be too peppery. Best to cook it in two waters to remove the strong taste. Properly cooked, tastes like salsify or parsnips. As a weed, it can be eliminated by simple hoeing.



Water Milfoil



Sarsaparilla



Ginseng

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Myrtales Family Haloragidaceae

Spiked Water Milfoil *Myriophyllum spicatum*

Stems weak and a number of feet long, depending much on depth of water. Leaves whorled, in 4's or 5's, with a central narrow rib from which equally narrow branches develop like parts of a feather, these portions being narrow enough to be thread-like. Leaves about the flowers entire and whorled.

Native of North America but also found in waters of Europe and Asia. In North America, ranges from Newfoundland to Maryland, west to California and Alaska. This species has not been correctly recorded from Florida. Some 20 species in the genus with wide distribution in the world.

Flowers held above water, in spikes surrounded by a whorl of very short leaves. Spike to 3 in. long. Petals, 4, drop off early. Stamens, 8, relatively inconspicuous. Fruit, small, to under $\frac{1}{10}$ in. long, with the parts rounded on the back, with a wide groove between ridges.

Supplies shelter and food for many insects that are food for fishes. Ducks feed on fruits and a few eat the foliage but it is not an important wildlife food. Muskrats eat whole plant sparingly and moose have been known to eat it. Related *Proserpinaca* is a valuable duck food.

Myriophyllum is often sold in aquarium supply shops as an aquarium plant because of its general beauty. Differences between species are usually not easily recognized from an examination of the leaves and even with the fruits the differences are sometimes slight.

Wild Sarsaparilla *Aralia nudicaulis*

Apparently stemless, as leaves seem to arise directly from root. There is, however, a short stem present. Leaves rise to a height of over 1 ft., petioles alone being that length. Leaves are compound, with 3 main sections, each with 3-5 slender stalked leaflets that may be to 5 inches long. Leaflet margins saw-toothed. Root, substantial and long.

Found commonly in woods from Newfoundland to Georgia, west to Manitoba, Idaho, Colorado, and Missouri. Not easily confused with other aralias of same range largely because it is apparently stemless and nearly smooth.

Flowers in 3 umbels, usually raised higher than highest leaf tip on a stem independent of single leaf that apparently starts at the root, greenish, to $\frac{1}{10}$ in. broad or slightly larger. Petals small, and conspicuously bent backwards. Stamens 5, greenish, conspicuous. Fruit a purple-black berry, $\frac{1}{4}$ in. through, borne in clusters.

Flowering time May and June, the fruit following for next 2 months. Root is strongly aromatic, used as a substitute for true sarsaparilla *Smilax officinalis*, forming basis for some of flavoring in root beer. Rather strong if eaten directly.

Indians formerly used root as an emergency food particularly when they were on forced marches, or long journeys. The plant is known as shorbbush, rabbit's-root, wild licorice, and false sarsaparilla. It has some medicinal properties. The true sarsaparilla grows in Honduras.

Order Umbellales Family Araliaceae

Ginseng *Panax quinquefolium*

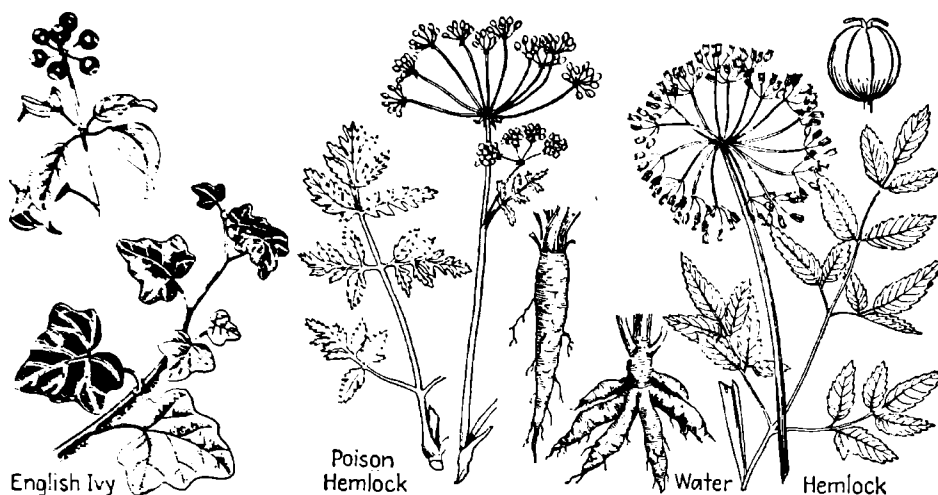
Perennial herb. Height to 15 in. Single erect relatively slender stem bears about 3 leaves at crest, each composed of 5 thin pointed leaflets that arise from a common point at the end of petioles that are to 4 in. long. Leaf looks much like that of a small horse chestnut. Flower cluster arises from between leaves.

Native of rich woodlands from Quebec to Alabama, west to Minnesota, Missouri, and Nebraska. Has been grown extensively. Root so valuable that wild stock has practically vanished from existence. 7 species in the genus native of eastern North America and of Asia.

Flowers in an umbel containing from a half-dozen to over 5 dozen, each flower under $\frac{1}{10}$ in. broad, yellowish-green, with some staminate that smell like lily of the valley and others with stamens and pistils. Whole cluster makes a single globular mass. Fruit a bright ruby-red berry, to nearly $\frac{1}{2}$ in. through, containing 2-3 seeds.

Reproduction by division of root or by seeds. Seeds ripen in September; may germinate first season or second. Roots may develop to sale size in 3-4 years. Plants are grown under artificial shade. Roots are large and believed by Chinese to have remarkable medicinal properties.

Roots divided so that they resemble a man with legs are considered most valuable and the name ginseng is from the Chinese "jin-chen" meaning man-like. Apparently, medicinal properties are more imagined than real and Americans who increased root weights by burying nails in them and letting root cover the nail injured the market for American stock.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales

Family Araliaceae

English Ivy
Hedera helix

Creeping and climbing vines that cling to walls with assistance of vigorous abundant holdfasts. Leaves evergreen, 3-5-lobed, dark-green above and much lighter beneath, with lighter colored veins, to 5 in. across, rather stiff, with margins that are essentially entire.

Native of the area from the Canary Islands to Asia but grown extensively as a covering for brick walls of buildings, being particularly popular on college buildings. Many races and varieties have been developed during years the plant has been under cultivation, and a half-dozen species native from Europe to Japan.

Flowers imperfect, greenish, in umbels at ends of branches. Calyx 5-parted or 5-toothed. Petals, 5, small. Stamens, 5. Ovary, 5-celled. Fruit black or yellow, globular, to $\frac{1}{4}$ in. in diameter, containing relatively few seeds embedded in flesh, the usual number being under 5.

Leaves and berries contain poisonous glucoside hederin. Children who eat the berries or cattle who eat the leaves may be poisoned by them. Some persons suffer from a severe dermatitis after handling the leaves or stems, or merely picking up the drying clippings after the plant has been pruned.

Commonest use is as a wall cover or as a house plant. The so-called "ivy league" of colleges is composed of the longer established institutions of the Northeast whose buildings characteristically bear English ivy and possibly some English traditions. Plant may be reproduced by seeds or by simple cuttings.

Poison Hemlock
Conium maculatum

Herb. Perennial. Erect. Height to 5 ft. Profusely branched in upper portions. Lower leaves with long petioles and, like upper petioleless leaves, at least twice compound, with leaflets thin with toothed margins. Base of petioles somewhat inflated and enclosing the stem.

Naturalized from Europe and well-established in wet waste places from Nova Scotia to Delaware, west through Michigan and on to California though the range is not continuous. Found in Mexico, in South America, and other parts of the world.

Flowers borne in umbels to 3 in. broad, with some tendency to be flat-topped, with each umbel supported by a ray to $1\frac{1}{2}$ in. long which arises from a point with other umbels. Flowers white but under $\frac{1}{10}$ in. broad. Fruits a pair of nutlets, each with 5 ribs that are prominent when dry.

Poison is particularly concentrated in fruits at fruiting time and is a volatile alkaloid, coniine. There are also conhydrine and methylconiine. While the root is reported to be harmless in spring, at least one death was caused by eating it when it was mistaken for Jerusalem artichokes.

Seeds may be easily mistaken for anise but should not be. This plant was used by the Greeks as a means of quick death for disposing of prisoners before the refinements of modern warfare had been discovered. This is probably the hemlock Socrates drank.

Family Umbelliferae

Water Hemlock
Cicuta maculata

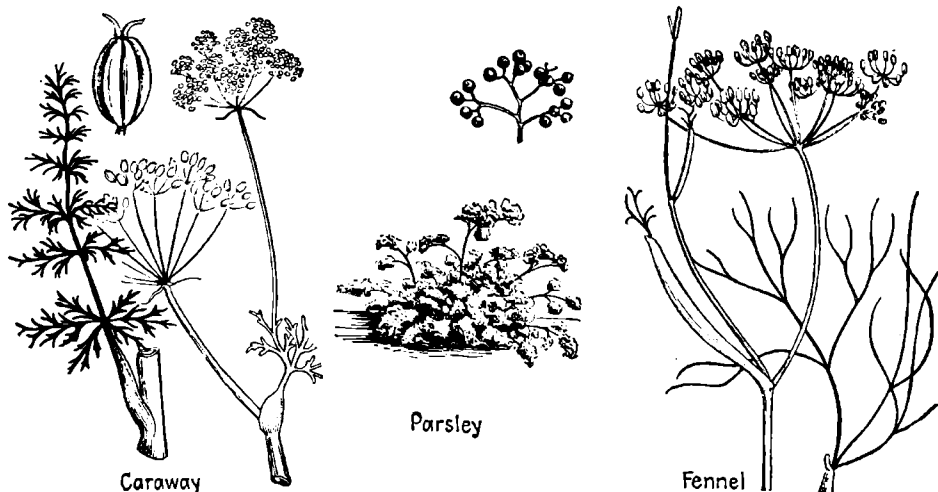
Herb. Perennial. Height to 6 ft. Smooth hollow conspicuously jointed stems, often purple at the joints. Leaves alternate, 2-3 times compound, with a conspicuous sheathing petiole base, to 1 ft. long or more. Upper leaves smaller than lower. Roots several, tuber-like, fleshy and have appearance of being edible.

Native of North America ranging from New Brunswick to Florida, west to Manitoba and New Mexico. Common in swamps and low grounds where it is wetter than habitat of poison hemlock. 8 species in the genus in North America including Mexico, of which 4 are definitely western.

Flowers, many in each of a number of umbels making up a compound umbel, white, with 5 white petals and 5 stamens. Fruit slightly over $\frac{1}{10}$ in. long, composed of 2 segments grown together, making an almost globular structure except for being flattened and for prominent corky ribs between, which are solitary oil tubes.

Rootstock shows plate-like cross partitions when cut lengthwise. If cut crosswise exudes aromatic yellow oil. Poisonous property in the roots, leaves, and fruits are cicutoxin and dilute alkali. Rootstocks richest in poison. Tops may be eaten safely by cattle in hay. Root size of walnut can kill a cow in spring.

Poisoning by poison hemlock is fatal, usually without convulsions; water hemlock poisoning involves violent convulsions following labored breathing, mouth frothing, loss of sight, vomiting, increased pulse, diarrhea, and great pain. Induced vomiting or purgatives to eject the poison seems to be best treatment.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales. Family Umbelliferae

Caraway

Carum carvi

Perennial or biennial herb. Height to 3 ft. Stems slender, erect, smooth, furrowed, hollow. Leaves compounded like the parts of a feather into many narrow segments, twice or thrice compounded, smooth, light green. Bases of petioles widely dilated and clasp the stem. Bracts at base of flower cluster, 3, narrow. Roots thick, spindle-shaped, tuberous.

Native of Old World but well-naturalized in many parts of America. Not uncommon as a weed in waste places from Newfoundland to Pennsylvania, west to South Dakota and Colorado. Probably named from Caria, a place in Asia Minor. Some 50 species native of temperate and warmer parts of the world.

Flowers small, pink, or more commonly white, appearing in May and June, in compound umbels to $2\frac{1}{2}$ in. broad and of to 10 major rays, each to 2 in. long. Fruits about $\frac{1}{8}$ in. long, brown, with alternating light and dark brown ridges and grooves, with 2 more or less connected. Cut across, fruits show 1-2 oil tubes to each groove.

Fruit yields a volatile oil, about 5% of which is used in making commercial tincture of cardamom. Fruits find commercial outlet as flavoring for breads, cakes and as added flavor for candies. Plants easy to cultivate, being raised much as are carrots. In Europe, plant is known as kummel.

As a medicinal agent, relieves gas in stomach. Also serves as stimulant, as a flavor for perfumery and liqueurs, and as a common home medicine that may be used safely without expert advice in treating mild cases of colic. Usual dose, 1 tsp. of fruits cut small to 1 cup of boiling water, a cupful being drunk slowly each day.

Parsley

Petroselinum crispum

Herb. Biennial or short-lived perennial. Height to 30 in. Much-branched, bright green, smooth, not too tough. Leaves compounded into 3's repeatedly with the last divisions deeply cut. Uppermost leaves smaller and in some cases entire. Leaves a deep rich bright green, sometimes crisped, and with a good taste.

Native of the Old World but much cultivated in gardens. Not infrequently escaped and established by itself about farm buildings, particularly in the Northeast. Probably native of Mediterranean region. 5 species in the genus, all native of Europe, and many cultivated varieties.

Flowers greenish-yellow, in flat-topped umbels, of which the whole group may be $2\frac{1}{2}$ in. across. Smaller umbels are grouped into a larger umbel whose rays or supports may be about 1 in. long. Petals inconspicuous and with incurved points. Fruit smooth, though ribs may be prominent when the fruit is dry, to $\frac{1}{2}$ in. long.

Seeds may be started in early spring in good soil in the open or in hotbed. Germination slow. Plants should be thinned so that they are 6-8 in. apart and should then be cultivated as one would an ordinary root crop. Leaves gathered fresh and used as soon as possible. For winter use, roots are planted indoors. Will withstand considerable frost.

Under cultivation for 2,000 years. One of the commonest plants used for garnishing fish, meats, and omelets and common ingredient of stuffing for fowl. The tops are sometimes boiled as a potherb.

Fennel

Foeniculum vulgare

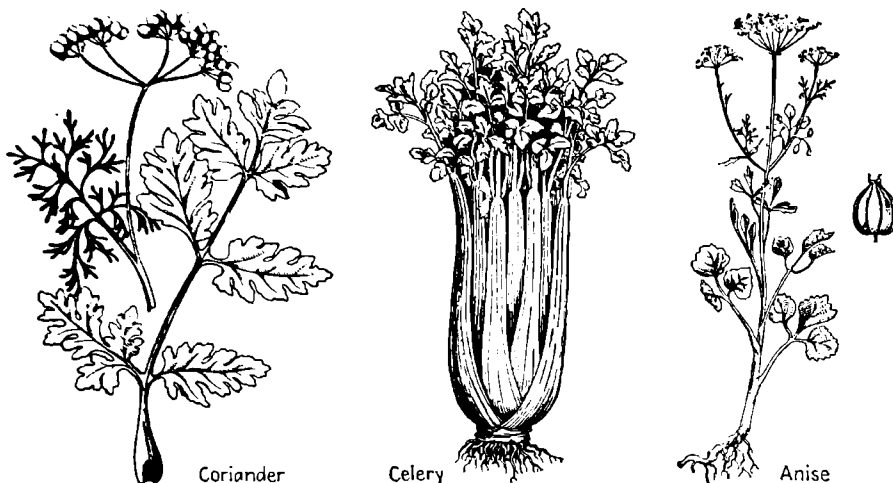
Height to 5 ft. Perennial. Stem erect, branched, more or less downy, moderately slender. Leaves 3-4 times compounded, in a feather-like arrangement, with narrow thread-like segments and with the bases of the long broad petioles clasping the stems. Whole plant is aromatic when it is crushed.

Native of southern Europe but rather widely and well established in America. Most common wild in America from Connecticut to Virginia, west to Missouri and Louisiana but grown in gardens almost everywhere. Commercial fennel comes for the most part from Germany. Grown by Chinese, Egyptians, Romans.

Flowers yellow, in large open, loose compound umbels, with to 25 major rays that are stout, smooth, and to $\frac{3}{4}$ in. long and smaller slender rays to $\frac{1}{2}$ in. long. Ripe fruits about $\frac{1}{4}$ in. long, slender, oblong, smooth, round in cross section, flattened from the back, with prominent dorsal ribs and single oil tubes between ribs in cross section.

Cultivation is simple and like that of carrots. Name refers to hay-like odor. Medicinal property a volatile oil found chiefly in nearly ripened fruit where it constitutes about 2-6% of the material. All parts of plant may be used. Fruits common in flavors for candy, perfume, soap, medicine, and liquor. Leaf stalks used as a vegetable.

Oil from fruits used chiefly to settle intestinal disturbances, such as gas on stomach; extracted commonly by steeping them in boiling water. Believed there will be a considerable commercial demand and its culture is reservedly recommended by some reliable resource commissions.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales. Family Umbelliferae

Coriander

Coriandrum sativum

Annual or perennial. Herb. Height to 3 ft. but usually less. Slender, erect, branching, smooth, strong-smelling. Leaves compounded into 3 parts or with parts arranged somewhat like those of a feather, with the uppermost leaves divided into fine slender parts which appear to be almost thread-like.

Native of Mediterranean region but most extensively grown in Morocco, India, and Europe. Found on waste ground from Massachusetts to North Carolina and to the Western states. Was mentioned in Egyptian, Hebrew, Sanskrit, and Roman literature. Name connected with Greek word for bug.

Flowers small, white or pinkish, in compound umbels to 2 in. broad, with slender rays. Outer flowers of cluster enlarged like ray flowers. Flowers appear in July. Fruits globular, yellow-brown, and when fresh have an unpleasant odor that is replaced by a fragrance when fruits are dried.

Dried fruits yield a volatile oil, coriandrol, at rate of $\frac{1}{2}$ –1%. Fruits used extensively for flavoring sweet dishes, particularly in India and in Europe. Essence of fruits considered better than the fruits themselves for flavoring purposes. Fruits are also candied, making the pleasing confection known as sugarplums.

Oil used as a medicine acts primarily in reducing gas in intestinal tract. Used in flavoring whisky, gin, and other liquors but probably the service rendered is not solely in adding flavor but more importantly in controlling digestive and intestinal disturbances caused by the liquor. Of considerable commercial importance.

Celery

Apium graveolens var. *dulce*

Perennial or biennial herb. Height to 3 ft. Stems much-branched, more or less grooved and jointed. Leaves compounded, in 2–3 pairs usually with an extra terminal one and each part compounded. We eat the petiole principally. Root leaves crowded, on a short stem before flowering time comes.

Native of marshy places from Sweden to Algeria, Egypt, Abyssinia, and in Asia to the Caucasus, Baluchistan, and mountainous India. Has been found growing wild, probably as an escape, in California, Tierra del Fuego, and New Zealand. Many varieties suitable for different climates, conditions, and appetites have been developed.

Flowers white, small, borne on stems of irregular length, among leaves and springing from joints in stem. Fruits small, compressed, prominently 2-angled, with large oil tubes showing in section. Seeds commonly soaked before planting, particularly for a late crop, and should not be dried too long in storage.

Seeds commonly sown 8–10 weeks before transplanting into field. In North, transplant at beginning of hot weather and store when sufficiently developed. In South, sow seeds in summer and shade to conserve moisture. 2 oz. of seed enough for 1 acre where grown in single rows 3 ft. apart. Transplanting is done about 1 month after sowing.

One of most important of field crops. Storage should be at 32°F., the celery itself averaging 2–3° warmer than the room. Storage may be by burying in root cellar, by field trenching, or by mulching. Commercial storage plants can hold celery safely over 2 months. Was first grown for food in France in early seventeenth century.

Anise

Pimpinella anisum

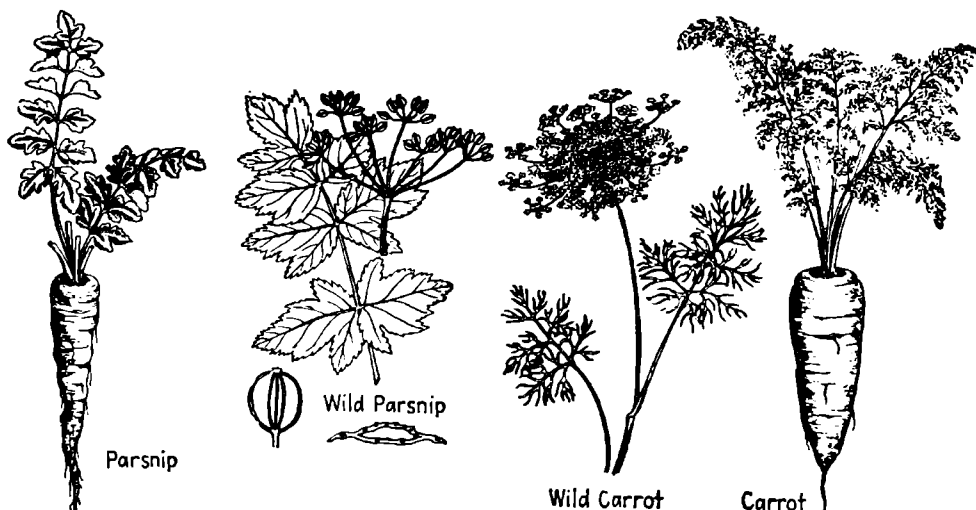
Herb. Perennial. Height to 2 ft. Erect, smooth, somewhat branched, rather slender. Leaves 3 times compounded, the basal ones with long petioles, or simple, with coarse teeth and broad lobes. Upper leaves have finer parts than lower. Root spindle-shaped, woody, with finer branches, from main axis.

Native of Egypt but now cultivated extensively in Asia Minor, India, and South America. Escaped from cultivation in warmer parts of Europe and in America over wide areas. Genus name refers to compound nature of leaves. Mentioned in earliest Greek, Hebrew, and Roman literature. According to Matthew 23:23 Pharisees gave tithes in anise.

Flowers small, yellow to white, in large loose open compound umbels. Fruit mature in late summer or in autumn, are not bristly or scaly, are about $\frac{1}{8}$ in. long, gray-brown, slightly downy, compressed from sides, with evident ribs. Oil from the fruit fragrant and stimulating to the taste, being somewhat sweetish.

Fruits provide an element used for flavoring bread and "licorice" candy and even for making medicines palatable. Between 1–3½% of the fruit is the volatile oil that may be extracted in part by water or almost wholly with the use of alcohol. Culture of the plant is simple and like that of carrots.

Distilled oil is used in preventing nausea and in treatment of colic in children. The stimulation of taste makes it popular with manufacturers of beverages who like to maintain sales demand. Oil is used in perfumery, candy, and sprays. The liqueur anisette gets its name from anise. Plant was used as a potherb in England about 1542 and was heavily taxed.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales. Family Umbelliferae

Parsnip

Pastinaca sativa

Stems with flowers reach a height of to 5 ft. are hollow, grooved, branched, and relatively stout. Biennial or perennial. Leaves compounded into 3-4 pairs of leaflets, with an odd leaflet at end; leaves appearing, on the whole, to be rather coarse. Upper leaves much smaller than lower. Large root may be 20 in. long.

Native of Europe. Under cultivation before beginning of Christian era. Now grown widely in the cooler temperate climates of world. Grows best in deep moist soil. When escaped from gardens, it loses its thick roots, sometimes becoming an annual. Under these circumstances may become a troublesome weed.

Flowers yellow or red, in compound umbels that are to 6 in. broad and composed of to 15 rather slender rays, each to 2 in. long, with final rays slender and to 2 in. long. Fruits developed the second season with exhaustion of large root, which the first season may reach a diameter of to 4 in. Seeds may live 2 years.

Seeds planted at rate of 4-8 lb. per acre for stock, or 1 oz. for every 200 ft. of row, or 3-4 lb. per acre in rows 15 in. apart when hand-cultivated. Radish seeds often sown in row with parsnip since they mature early without interfering with parsnip development. Parsnips delicate when young and do not withstand weeds.

Grown extensively as commercial crop, yielding to over \$200 per acre but much is absorbed by labor costs. Deep roots make harvest expensive. Quality improves with storage, those stored 2 weeks at 34°F. equaling others left in ground over 2 months, the change being from starch to sugar such as sucrose. Wild parsnip may cause serious dermatitis to wet skin.

Wild Carrot, Queen Anne's Lace

Daucus carota

Biennial. Height to 3 ft. Erect, bristly, branched above, with rather slender but nonetheless strong stem. Leaves lower and basal, 2-3 times compounded, segments being relatively slender but not linear and smaller units being conspicuously saw-toothed. Upper leaves smaller and less finely divided.

Native of Asia but naturalized from Europe. Now commonly established as a weed in fields, pastures, and waste places. Found from coast to coast in North America but may be commoner in East. 25 species in the genus. From this species has been developed the valuable cultivated carrot.

Flowers borne in compound umbels that total to 4 in. across and open or close according to humidity, with crowded rays, outer ones being to 2 in. long; rays of smaller umbels, slender and to $\frac{1}{8}$ in. long. Flowers white except that the central one in whole umbel may be purple to almost black. Fruits with bristly back, to $\frac{1}{8}$ in. long.

Flowering time from June through September. Fruits may be found at almost any time of year since tops persist above snow and through early summer. Pollination effected by butterflies, moths, bees, flies, and other insects if this can be judged by visits made. Insects possibly attracted by strong odor of plant.

Queen Anne's lace considered a beautiful plant by some flower lovers, but same plant known as wild carrot is considered a despicable and pernicious weed by farmers. Seeds persist long in the soil and so tops should not be allowed to come to fruit. Cultivation, hoeing and crop rotation will ordinarily keep plant in control. Wet leaves cause dermatitis.

Carrot

Daucus carota var. *sativa*

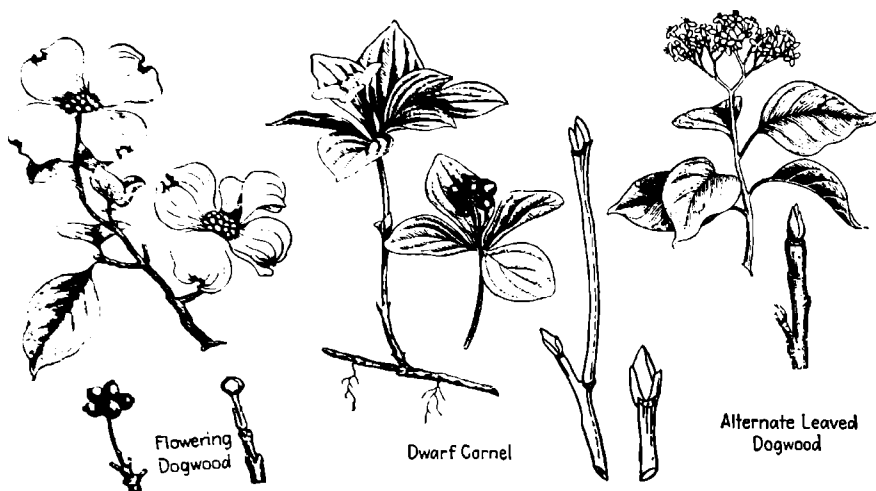
Height to 3 ft. Annual or biennial with top much-branched and more or less bristly hairy. Leaves on long petioles, finely divided so that finer segments seem almost linear. Root thick, coarse, orange-yellow, with substantial taproot that penetrates deeply and becomes swollen at end of first season, losing size with flowering.

Native of Africa, Europe, and Asia, widely spread. Now widely naturalized in America. Some species of carrots are native of North America. This variety was cultivated by the ancients but has proved popular as a food plant in America and Europe. It does best in deep, loose, loamy, rich soils, with large yields of early crops coming from sandy soils.

Flowers white or yellow, very numerous, bearing stamens and pistils. Fruits small, flattened or concave on one side, with rows of weakened spines on other, with oil glands under these secondary ribs. 3 lb. of seed needed for planting an acre that is to be hand-cultivated in rows 18 in. apart; 4-6 lb. where sown for stock feed.

Seeds covered to depth of $\frac{1}{2}$ - $\frac{3}{4}$ in. the lighter soils favoring deeper burying. Quick-maturing varieties may be harvested from seeds sown 2 months before a killing frost; others require to 3 months. Carrots $\frac{3}{4}$ in. through are harvested and sold in bunches. They keep well for 6 months at 32°F., deterioration being largely due to sugar loss in respiration.

United States crop of commercially grown carrots is on the increase. Food value of root is high. 10 tons of carrots will remove from the soil 100 lb. of potash, 32 lb. of nitrogen, 18 lb. of phosphoric acid. Yield in acid soils is low or negligible. Such soils should not be used for growing the plant commercially.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales. Family Cornaceae

Flowering Dogwood
Cornus florida

Tree or large shrub. Reaches height of to 40 ft., with rough "alligator" bark that is close and relatively uniform. Leaves opposite, dark-green above and lighter beneath, smooth or finely hairy above, to 6 in. long, narrowed at base and pointed at tip. Twigs green and rubbery. Root system spreading.

Found in woods and on hillsides, usually among other woody plants, on sandy or gravelly soils but mostly where soil is somewhat acid. Ranges from Maine to Ontario, south to Florida, Kentucky, Minnesota, and Kansas, reaching an elevation of 4,000 ft. in Virginia, with close relatives west to the Pacific Coast.

Flowers in small compact clusters, in center of a cluster of 4 showy greenish, white, or pinkish bracts that are ordinarily considered to be the flowers. Flowers appear from April through June and make the plant most attractive. Fruits appear later and through to winter as scarlet structures to $\frac{1}{2}$ in. long crowned by the persistent calyx.

Name cornus means horn, which refers to nature of the wood. Wood brown, weighing to 50 lb. per cu. ft. Leaves in autumn often turn brilliant red. Fruits sometimes persist through winter making plant attractive throughout year because of flowers, leaves, fruit, and bark. Has few obnoxious insect pests.

Commonly planted as an ornamental but not always with success. Fruits collected in September yield 4,200 seeds per lb. with good germination, may be stored by burying for 2 years, to be planted in spring at $\frac{1}{4}$ in. depth. Has common name of boxwood, false boxwood, cornelian tree, white cornel, nature's mistake, and Indian arrow-wood.

Dwarf Cornel, Bunchberry
Cornus canadensis

Woody at base but herbaceous at top of stem that is erect, to 9 in. tall, scaly and arising from a slender creeping underground rootstock. Leaves opposite, short-petioled, uppermost crowded into what seems to be a whorl, somewhat downy or smooth, acute at each end, entire, to 3 in. long, conspicuously veined.

Native of North America and found in cool low woodlands from Newfoundland to New Jersey and west to Minnesota, Colorado, California, and Alaska. Obviously closely related to flowering dogwood, which is a tall tree in some parts of its range.

Flowers borne in a greenish-white cluster surrounded with 4-6 petal-like white pointed leaves that appear to make up the flower petals, the whole cluster borne on a slender stem to $1\frac{1}{2}$ in. long. Fruit a bright red globular berry, about $\frac{1}{4}$ in. in diameter, containing a smooth globular stone a bit longer than it is broad.

Berries considered edible but are tasteless. It has been suggested that with the addition of some flavoring such as lemon juice a palatable dish might be made from the berries but it would seem that many superior fruits could be found wherever lemon juice was available.

Plant is attractive and finds a place in some wild gardens. Because of its beauty, it deserves protection from thoughtless pickers of wild flowers. Ripe berries have been used to catch minnows for bait when other initial baits were not available.

Alternate-leaved Dogwood
Cornus alternifolia

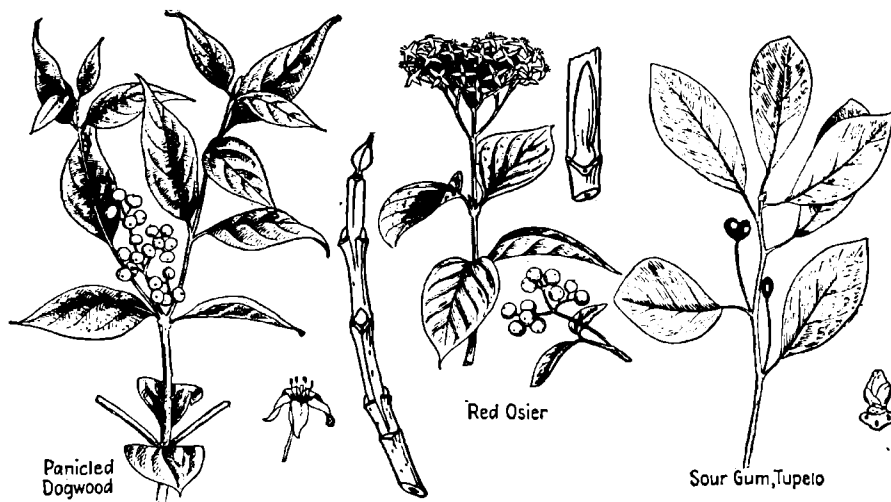
Shrub or tree. Height to 30 ft. Trunk diameter to 8 in. Unique branching resembling that of a deer's antlers is caused by unequal length of areas between leaves. Leaves alternate, slender-petioled, clustered near ends of year's growth, to 4 in. long, smooth above and pale downy beneath.

Native of North America. Found in shady woodlands, from Nova Scotia to Georgia, west to Minnesota, Missouri, and Alabama, reaching an elevation of 2,500 ft. in Virginia. Some 20 species in the genus native in the north temperate zone, Peru, and Mexico, of which most have opposite leaves although this one does not.

Flowers in downy flat-topped clusters to 4 in. across. Petals white or creamy, slender. Flowers with number of petals equaling number of stamens; perals, to $\frac{1}{2}$ in. long, reflexed. Fruit borne on red stems in loose open clusters, almost spherical, dark blue-black or sometimes yellow, $\frac{1}{2}$ in. through, 1-2-seeded.

Wood hard reddish-brown, weighs 42 lb. per cu. ft., with light sapwood, to 20-30 annual layers' thickness. Plant is subject to a twig blight that turns twigs yellow and may kill the whole plant. Flowers May to July. Fruits may remain on until fall unless eaten.

11 species of birds, including ruffed grouse, known to feed on berries. Cottontails and white-tailed deer have been observed feeding on plant. Sometimes grown as an ornamental in the East, but because of twig blight is hardly a wise selection for permanent ornament. Known as umbrellatree, pigeonberry, blue dogwood, purple dogwood, and green osier.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Umbellales. Family Cornaceae

Gray Dogwood
Cornus racemosa

Shrub. Height to 15 ft. Twigs and bark smooth, gray. Leaves opposite, to 4 in. long, wedge-shaped or blunt at base, relatively long-pointed at tip; when full grown, finely downy above and below, often pale below, with slender petioles, entire; when first emerge from bud leaves are pale green with red tinge and slightly downy.

Native of North America. Found along stream borders, by thickets, at woodland borders, or in ornamental plantings from Maine to North Carolina, west to Minnesota and Nebraska. Has been recommended for wholesale planting for soil control and so its range must be greatly increased as it is relatively hardy.

Flowers in loose open clusters, not necessarily flat-topped, to 2½ in. across, but the individual flowers are small, white, and borne on smooth rays. Fruit white, to ¼ in. through, with a furrowed stone that is slightly broader than high and essentially globular.

Flowers May and June. Fruits appear August through November, though they may persist through winter. Easily propagated by cuttings or by seeds, of which there are 3,500 to the pound, uncleaned. Plant endures city smoke well and occurs on clay, sand, or gravel soils, dry or moist, in the sun or shade.

Fruits eaten by pheasant, bobwhite, ruffed grouse, and sharp-tailed grouse, making up about 5% of the total annual fruit food of pheasants and being one of most important pheasant foods in southern Michigan even into May. Plants also eaten by cottontail rabbit. A popular hedge plant grown for ornamental purposes. State flower of Virginia.

Red Osier Dogwood
Cornus stolonifera

Shrub. Height to 10 ft. Usually sends many branches erect from prostrate branches to make a dense thicket. Twigs smooth, bright reddish-purple, or downy when young. Leaves to 5 in. long, slender-petioled, smooth on both sides or downy above or below, whitish or pale beneath and darker above. Root system relatively shallow.

Native of North America. Found in wet or moist soil or planted in hedges and borders from Newfoundland to Virginia, west to Yukon Territory and California, being found up to 2,400-ft. elevation in New York. Related silky dogwood *C. amomum* has silky leaves and twigs, and panicked dogwood *C. paniculata* has grayish twigs.

Flowers in flat-topped clusters to 2 in. across, with supporting twigs downy and white; relatively few flowers in a cluster, with no conspicuous bracts such as are found in dwarf cornel or flowering dogwood. Fruit white to blue, globular, to ½ in. through, with stone that varies greatly in general size.

Does best in moist but well-drained area, in sun or in shade. Flowers May through July. Survives in alkaline soil, new erect shoots arising from branches that touch the ground. About 17,300 seeds per lb. Seeds may be collected at almost any time of year though most abundantly in late summer and fall.

Known to supply food to ruffed grouse, bobwhite, sharp-tailed grouse, Hungarian partridge, elk, deer, moose, snowshoe hare, and mule deer. Used extensively as an ornamental and easily propagated by cuttings either in fall or spring or by layering and then cutting off the rooted stock.

Sour Gum, Pepperidge
Nyssa sylvatica

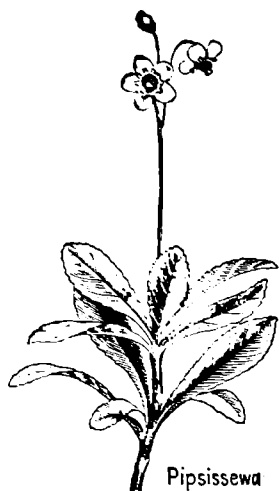
Tree. Height to 120 ft. Trunk diameter to 5 ft. Bark to 1½ in. thick, light brown or tinged with red, deeply fissured. Leaves crowded at twig ends in lateral branches or remote on vigorous shoots, alternate, entire, with slightly thickened margins, to 5 in. long and to 3 in. wide. Roots thick and hard.

Found in swamps or at their borders in poorly drained soil, and, in southern part of range, on mountain slopes. Ranges from Maine to Florida, west to Michigan and Texas, with closely related species within much the same range or extending it only slightly. 7 species in the genus native of eastern North America and Asia.

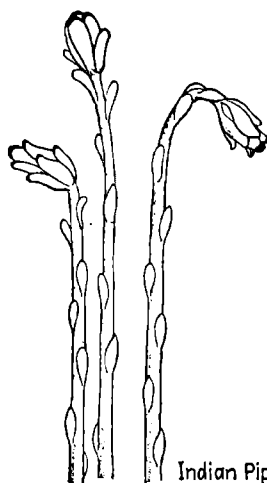
Flowers appear in early spring when leaves are about ½ grown, in many-flowered, rather compact clusters with staminate with more flowers and in heads that droop, while pistillate have 2 to a few flowers in heads that do not droop. Stamens in staminate flower shorter than petals in pistillate. Fruit dark-blue, to ¾ in. long.

Wood hard, heavy, weighing to 40 lb. per cu. ft., tough, not durable, light yellow to white, with thick dark sapwood to 100 annual layers thick. Has few insect pests. Tree resists fire well but not wind. Seeds 3,000-4,000 per lb., from stone fruit appearing in September and October but persisting through winter.

Wood used for wheel hubs, ox yokes, shoe soles, wharf piles. A beautiful tree in autumn, when it is the first to turn a brilliant red. Grown sometimes as an ornamental. Fruits eaten by ruffed grouse, bobwhite, wild turkey, pheasant, prairie chicken, black bear, white-tailed deer, marsh rabbit, and other game species. Fruit makes excellent preserves.



Pipsissewa



Indian Pipe



Labrador Tea

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ericales. Family Ericaceae

Pipsissewa

Chimaphila umbellata

Evergreen, woody, with erect stem rising from a sprawling stem to a height of 1 ft. Stem rather tough and not much branched in erect portion. Leaves thick shining dark-green, to 2½ in. long and to 1 in. wide, not mottled, broader toward tip, with fine, sharp, small saw teeth along edge.

Native of North America, Asia, and Europe. Found in America in dry deep woodlands from Nova Scotia to British Columbia, south to California, Mexico, and Georgia, being possibly more abundant in the West than in the East. Most common under evergreen trees such as pines, hemlocks, and spruces.

Flowers white, pink, or flesh-colored, waxy, dainty, with 5-lobed corolla commonly marked with a deep pinkish ring, lobes turning back as flower matures. Stamens, 10, with downy or hairy filaments. Fruit a capsule, to ½ in. through, globular, brown, dry, maturing in late summer.

Flowers June through August; visited by many kinds of bees and small flies that effect pollination, among the genera being *Andrena* and *Halictus*. Delicate scent of flowers and their pale color no doubt serve as an attraction. Leaves have a delicate flavor and are nibbled by woodsmen.

The drug chimaphilin is a fluidextract of this plant, used as a diuretic, the average dosage being about 30 gr. A common ingredient in root beer. Plant is used in Christmas decorations. Known as love-in-winter, bitter winter-green, ground holly, noble pine, pine tulip, king's cure, and bittersweet.

Indian Pipe

Monotropa uniflora

Height to 10 in. When fresh is pinkish white but turns black at maturity; finally loses its succulence and becomes brown and relatively dry. Stems arise in clusters from spreading brittle matted masses of roots. Only leaves are rudimentary, scale-like, scattered along erect stem bearing the flower.

Found in rich moist woodlands where shade is heavy, from Anticosti Island south to Florida, west to Washington and California thus including practically all of United States. In North Carolina it reaches an elevation of 4,200 ft. Ranges south into Mexico and is found in Japan and in Himalayas. There are 2 species, one ranging into Colombia.

Flowers borne singly at top of flowering stalk, at first drooping to form a "pipe" but later becoming erect when the fruit is formed. Sometimes 2 flowers to a stalk. Flower to 1 in. long, with 4-6 petals and 10 stamens. Fruit erect, obtuse-angled capsule, nearly ½ in. through.

Lives chiefly on decaying woody plant material, so needs no green tissue to use in manufacture of food for itself. Entire root system compacted into an almost solid clump of fungus mycelium so that roots themselves do not come into contact with soil but receive their nourishment from the fungi, which in turn get theirs from the decaying wood.

Botanists do not always agree as to dependence of this plant on fungi that constitute its substitute for a root system but it is certain Indian pipe could not grow in wild without assistance of fungi. Possible the fungi may receive something in return from the Indian pipe. Related false beechdrops *M. hypopitys* is fragrant and bears many flowers; considered edible by some persons.

Labrador Tea

Ledum groenlandicum

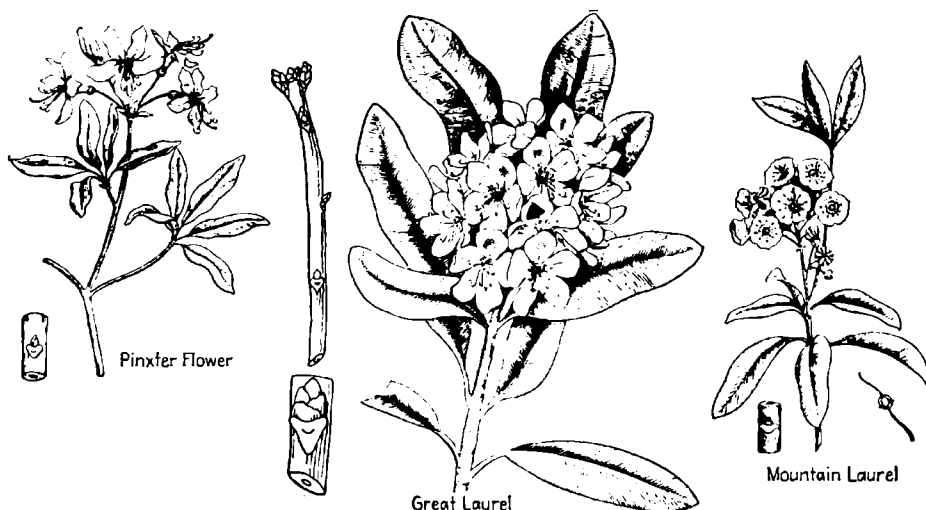
Shrub. Height to 4 ft. but usually much lower. Twigs densely fuzzy. Leaves to 2 in. long and to ¾ in. wide, dark green; roughened above, with incurving edges bending toward the brown-wool-covered undersurface, alternate, usually more abundant in upper portions of stem, evergreen.

Relatively common in peat bogs. Sometimes found in swamps from Greenland and Labrador, south to Pennsylvania and west to British Columbia and Washington. It survives in well-drained or in water-soaked soil, in sun or in shade. 5 species in the genus extend range from coast to coast and into subarctic regions.

Flowers to nearly ½ in. across, in many-flowered terminal clusters at top of plant, each borne on brown downy stems that are to 1 in. long and recurved when fruits are formed. Stamens, 5-7. Fruit a nodding, oblong capsule about ¼ in. long, bearing elongate seeds. Flowering time May through August. Fruit available in August.

At its best in sour peat bogs where it often forms dominant plant along edges. Ecologists use unique form of leaf to illustrate what they call "roll-leaf" form of a plant to be found growing in water that may be physiologically useless because of its chemical content.

Early explorers called it "muskeg tea" and made a substitute for tea from its leaves. Linnaeus stated that the leaves were frequently mixed with stored corn to keep mice away. It appears in the list of useful medicinal plants issued by quack herb doctors but not in accepted medical literature. It is reported to be a poisonous browse for sheep.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ericales. Family Ericaceae

Pink Azalea, Pinxter Flower
Rhododendron nudiflorum

Shrub. To 6 ft. high, well-branched above, with conspicuous terminal buds from which many new smooth or stiff-haired twigs arise with the new year's growth. Leaves more or less pointed at each end, to 4 in. long, with hairy margins; more hairy when young than when old. Root system substantial and relatively tough.

Relatively common in sour soils, open or thick woodlands, over sand or gravel or even in swamps and bogs. Ranges from Massachusetts and New Hampshire south along mountains to Florida and Texas, reaching an elevation in Virginia of 3,000 ft. Relatively commonly planted as ornamental about homes.

Flowers pink or white, expanding from a short, narrow tube into a showy, somewhat 2-lipped, nearly 2-in. broad bloom. Blooms April through to June. Stamens conspicuously long, spreading, with pistil tip curving upward. Fruit an erect rather slender capsule to $\frac{3}{4}$ in. long, splitting to free seeds. Pollination by honeybees and moths.

May be transplanted in spring but not in fall. Should not be placed where they will get full glare of sun. Soil should be well-watered and sour rather than limed. Horticulturalists graft plants freely. In winter, young plants may be temporarily protected by a leaf mulch but mature plants should be hardy in their range.

Valuable wild and ornamental shrub protected from despoilation by law in some states. Should be more thoroughly protected. Plucked flowers do not survive long and so are not satisfactory material for bouquets. An edible, juicy gall may be found on twigs or leaves by end of May that is delicious eaten fresh or may be pickled in vinegar for later use.

Great Laurel
Rhododendron maximum

Height to 40 ft. Trunk diameter to 1 ft. Leaves to 7 in. long and to $2\frac{1}{2}$ in. wide, evergreen, tough, thick, smooth beneath, dark-green on both sides, drooping in winter, somewhat curled in bitter cold weather, on stout petioles to 1 in. long, rather pointed at end. Root system sturdy but compact.

In woods and along streams or sometimes in bogs, usually where there is muck, gravel, or damp rocky soil, usually sour but not commonly with limy soils or exposures. Ranges from Nova Scotia to Quebec and Ontario, south through Ohio and New England to Alabama and Georgia with related species to west.

Flowers showy, to 2 in. broad, borne on sticky stems, white, purple, or rose-colored, with yellowish or whitish spots within, somewhat waxy in appearance. Calyx nearly as long as petals but hidden by them. Fruit a somewhat fuzzy capsule, to $\frac{1}{2}$ in. high. Flowers appear from June through July. Pollination probably by bees.

Wood one of hardest and strongest, weighing 39 lb. per cu. ft., light brown. Green parts contain the poison andromedotoxin that may be injurious or fatal to sheep and other animals that eat leaves when more desirable forage is not present. Honey from bees feeding on nectar reported to be poisonous.

Rhododendron of this or related species is the State flower of West Virginia and of Washington. Some 100 species, of which this is most popular as a landscaping plant. Transplants well, forms a dense year-round bank, and is attractive because of leaves or flowers. Poisonous properties not commonly troublesome. Deer eat small quantities safely.

Mountain Laurel
Kalmia latifolia

Shrub. To 20 ft. high, forming dense thickets, with stiff round twigs. Sometimes grows to tree size, to 40 ft. high. Leaves alternate or sometimes a few opposite, smooth dark-green, evergreen, pointed at each end, to 5 in. long and to $1\frac{1}{2}$ in. wide, with margins somewhat curved in toward underside. Root system tough and persistent.

Common in rocky and sandy soils, sometimes forming extensive pure stands. Frequently grows where other plants could not survive. Ranges from New Brunswick to Ontario, Indiana, and Kentucky, south to Florida and Louisiana but more abundant in middle of this range.

Flowers beautiful, pink or white, to $\frac{3}{4}$ in. across, in compact clusters at end of twigs, erect, on densely glandular slender stems. Stamens about twice as many as petals and close to them, surrounding longer up-curving pistil bearing web-entangled pollen that attaches itself to visiting insects, effecting pollination.

Wood very hard, fine, brown, weighing 44 lb. per cu. ft., used in making wooden implements that need to be carved. Green parts contain the poison andromedotoxin, most commonly eaten by sheep causing intense salivation and even paralysis but an animal ill for 2 days may yet recover. Honey derived from flowers may be fatally poisonous.

Used most commonly as Christmas decoration for city streets. A legitimate crop if harvested wisely for decoration where abundant. Used also in making wooden tools. Has been called spoonwood, broad-leaved kalmia, ivy bush, big-leaved ivy, poison laurel, calico bush, and American laurel. Eaten sparingly by deer and grouse. It is State flower of Connecticut and of Pennsylvania.



Bog Rosemary



Leatherleaf



Sour Wood

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ericales. Family Ericaceae

Bog Rosemary *Andromeda polifolia*

Shrub. Height to 3 ft. Sparsely branched. Leaves rather crowded, slender, usually acute at tip and narrowed at base, sour, alternate, to $2\frac{1}{2}$ in. long and to $\frac{1}{3}$ in. wide, with margins curved sharply inward and downward, dark-green above and almost white beneath, short-petioled, evergreen.

Native of North America, Asia, and northern Europe. Found in bogs from Newfoundland to Alaska, south to British Columbia, Michigan, and northern Pennsylvania and New Jersey, with several close relatives extending range to south. Only a few species in the genus; only 3 native of the United States.

Flowers in few-flowered clusters borne at branch tips, nodding; pink or white in corolla and pale red in calyx. Stamens, 10. Although flowers nod, fruit becomes erect as it ripens. Fruit a reddish or brownish dry capsule about as long as it is wide. Flowers May through July.

Grows best in wet peat bogs exposed to sun, reproducing and spreading largely by creeping rootstocks. Rarely attacked by any insects or by fungi. Leaves contain the poison andromedotoxin, but this is rarely troublesome since leaves are too bitter to be eaten in abundance. Most dangerous in spring.

Fruits known to be eaten by ptarmigan, and leaves on occasion by stock. Does not survive as an ornamental in usual situations. Of interest to plant ecologists and physiologists because of nature of leaves in relation to nature of available water supply. Leaf covering probably limits loss of water reducing water needs of plant.

Leatherleaf, Cassandra *Chamaedaphne calyculata*

Shrub. Height to 4 ft. Profusely branched, with slender twigs and branches. Leaves leathery, oblong, thick, covered with fine round scales that rub off when young, to $1\frac{1}{2}$ in. long and less than half that width usually, evergreen, alternate, decreasing in size from bottom to top of plant.

Found in bogs and swamps in North America, in Europe, and in northern Asia. Ranges from Newfoundland to Georgia, west to British Columbia, doing well in moist or even in well-drained soils, but only on acid peat soils and preferably in a place exposed to sun. Only 1 species in the genus in North America.

Flowers borne along tips of uppermost branches, with small leaves at base of each, bell-shaped, hanging from one side of branch, white, with 5 acute sepals in calyx and 10 stamens. Fruit a 5-celled capsule bearing many flat seeds. Flowering time April through May or June.

Propagated by dividing mature plants or by growing seeds sown on sand and sphagnum moss under glass in winter or spring and transplanting them when sufficiently large. According to some authors leaves may contain the poison andromedotoxin but others recommend their use in making a tea substitute.

Fruits form staple winter food for sharp-tailed grouse. Plant is eaten freely by cottontail rabbits. Can hardly be considered as an ornamental since its soil requirements are such that it would be hard to grow in ordinary situations. Serve to consolidate floating peat bogs in which cranberries grow.

Sourwood, Sorrel Tree *Oxydendrum arboreum*

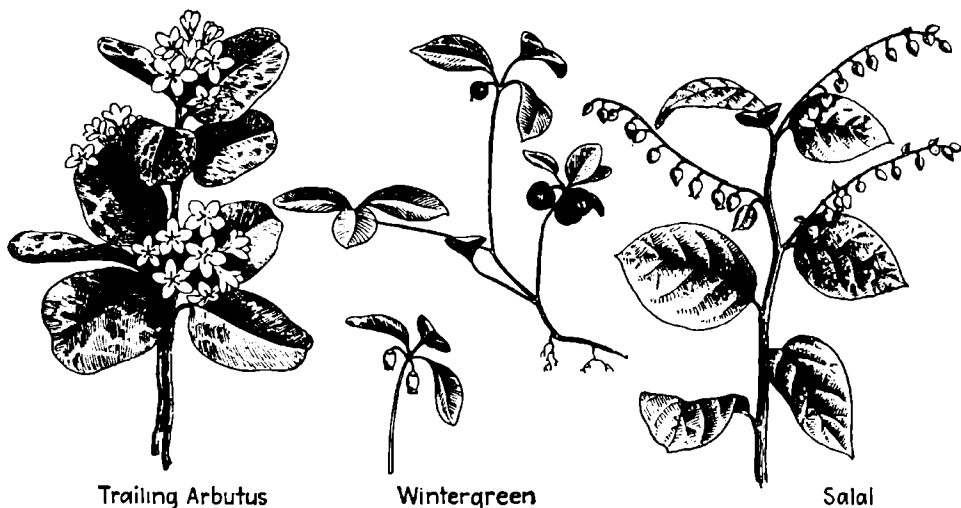
Tree. Height to 60 ft. Trunk diameter to $1\frac{1}{2}$ ft. Bark smooth on twigs and branches but deeply fissured on trunk. Leaves alternate, slender, essentially smooth, to 7 in. long, commonly somewhat wrinkled, entire, green on both sides, finely veined in a net-like manner, slender-stalked.

Native of North America and found ranging from Pennsylvania to Florida, west to Louisiana and Indiana but grown as an ornamental rather considerably outside normal range. Grows wild in woodlands associated with other species. In its southern range is more or less confined to higher lands.

Flowers borne in branching 1-sided clusters at ends of twigs, whole clusters being to 10 in. or more long and individual flowers being about $\frac{1}{2}$ in. long; like little bells constricted at free end, with shallow cup-like calyx at base. Fruit a capsule to $\frac{1}{2}$ in. long, ripening in September and October.

Flowering period June through August. Wood hard, reddish-brown, weighing 46 lb. per cu. ft. Tree survives in sun or shade in dry or well-drained soils, is rarely attacked by insects or by disease, turns a brilliant scarlet in autumn, is propagated by seeds sown in fall or spring under glass on sour soil.

Wood has occasional commercial uses but plant is best known as an ornamental. Sour leaves are commonly chewed by hikers as a thirst quencher. Flowers yield a nectar that is collected by bees and makes a good honey. Leaves are eaten by white-tailed deer as a forage. Known as elk tree, titi, and by other names.



Trailing Arbutus

Wintergreen

Salal

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ericales. Family Ericaceae

Trailing Arbutus
Epigaea repens

Trailing woody vine. To 15 ft. long; slender with hairy branches that are tough, branching, and close to ground. Leaves alternate, thick, dark-green above, coarsely veined, heart-shaped or rounded at base, mostly smooth above and somewhat hairy beneath, to 3 in. long and $1\frac{1}{2}$ in. wide, on short petioles. Roots tough.

Found in pastures, rocky woods, and sandy regions, but most particularly in or under evergreen woodlands, often in large patches more or less completely covering ground. Ranges from Newfoundland to Saskatchewan, south to Florida, Kentucky, and Wisconsin and sometimes established in wild gardens.

Flowers in clusters of few to several, intensely fragrant, pink or white, to $\frac{3}{4}$ in. long and nearly as broad with the 5 petals expanding and longer than the sepals. Fruit breaks into 5 sections that spread apart exposing a white fleshy interior. Flowers March to May. Pollination most commonly by early flying queen bumblebees. Flowers of 3 types.

Leaves reputed to have an astringent tonic though this is not always recognized as important. A related species is found in Japan. A taller plant that is not the trailing arbutus goes by name of arbutus. Genus name *Epigaea* means in Greek on the earth and refers to trailing habit.

State flower of Massachusetts. Known as shadflower, gravel pink, winter pink, mountain pink, Mayflower, and ground laurel. Is protected against collectors by law in some states. Should not be destroyed nor should its sale be encouraged or legalized. Flowers eaten to relieve thirst; taste spicy.

Wintergreen, Checkerberry
Gaultheria procumbens

Stems woody, creeping, freely branching and bearing erect portions that reach a height of to 6 in. Smooth throughout, fragrant. Leaves clustered mostly at top of erect branches, dark-green, shining on upper surface and lighter beneath, to 2 in. long, rather leathery but tender and delicious when young.

Native of North America where it is found in woodlands, particularly of coniferous type, from Newfoundland to Georgia, west to Manitoba and West Virginia. About 100 species in the genus ranging through North America, through the Andes in South America and in Asia. Salal of Pacific Coast is in the group.

Flowers usually solitary in axils of leaves, borne on recurved stems that are to $\frac{1}{2}$ in. long. Corolla white, waxy, 5-toothed, to $\frac{1}{4}$ in. long. Stamens, 10, borne on inside of corolla. Fruit a bright red berry-like mealy, fragrant, 5-celled structure, ripening in autumn and increasing in size through winter.

Found on sandy and other soils, in sun or shade, in mats. Produces oil at rate of 1 lb. of oil to 1 ton of leaves. Similar oil obtained from birch and made synthetically. May be propagated by seeds sown under glass in winter or spring or by division. About 2,800 fresh berries per lb.

Leaves are delicious in spring, and fruits in winter. Commercial oil of wintergreen or of checkerberry comes mostly from birch or from synthesis. Plant eaten by bobwhite, ruffed grouse, sharp-tailed grouse, pheasant, mountain sheep, white-tailed deer, spruce grouse, and chipmunk. Mixture of blueberries and wintergreen is marvelous.

Salal
Gaultheria shallon

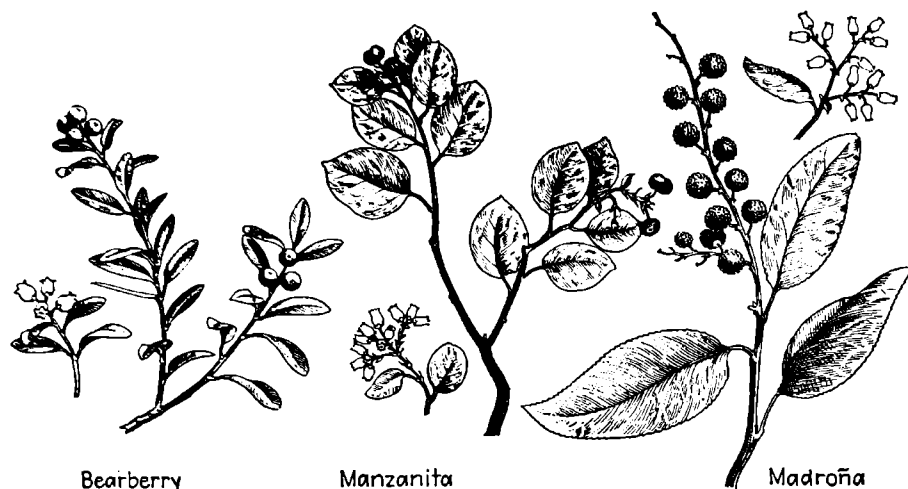
Shrub. Height to 2 ft. Spreading with somewhat hairy branches. Leaves evergreen, alternate, round or heart-shaped at base, to 4 in. long, dark-green, with margins somewhat broken, smooth when mature, with petiole to $\frac{1}{4}$ in. long, acute at free end. Branchlets fuzzy.

Native of western North America, ranging from Alaska to southern California, growing in dry or well-drained areas either in sun or in shade but needing a humid atmosphere to reach maximum development. About 100 species of the genus, best known in the East being wintergreen or checkerberry.

Flowers in slender clusters to 5 in. long, nodding, borne from tip of branches or from leaf axils. Calyx white or whitish, fuzzy, with triangular lobes. Corolla fuzzy, white or pink, to $\frac{1}{2}$ in. long. Fruit purple at first; when mature, black or indigo, hairy, about $\frac{1}{4}$ in. across.

Flowers borne in May and June. Fruits July through December. In dry sunny situations plants are dwarfed; but in humid regions on sandy soil near sea may form a dense mat. May be propagated by sowing seeds in winter or spring under glass and transplanting seedlings.

Known as salal or shallon. Used primarily as an evergreen ornamental shrub but of importance as an emergency food. Eaten regularly by Indians. Not palatable for livestock but is important food for Roosevelt elk, an emergency food for Olympic wapiti, and food for mountain beaver, deer, bear, grouse, pigeons, and chipmunks.



Bearberry

Manzanita

Madroña

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Ericales. Family Ericaceae

Bearberry

Arctostaphylos uva-ursi

Trailing or sprawling, branched, shrubby plant with branches to 2 ft. long but usually sprawling close to ground. Twigs finely fuzzy. Leaves evergreen, entire, smooth or finely fuzzy toward base, somewhat leathery, to 1 in. long and to $\frac{1}{2}$ in. wide, with fine crooked veins and short petioles, or sometimes apparently none.

Native of North America. Ranges from Labrador to Virginia, west to California, north through Arctic America to Alaska. Also found in northern Europe and in Asia. Some 40 species in the genus, of which this one is widely spread and others are better known in western North America.

Flowers borne in small, few-flowered clusters at ends of branches. Corolla white, narrowest at free end that shows 5 shallow lobes, and bears, inside at the base, 10 or sometimes 8 stamens shorter than the pistil, which is, in turn, usually shorter than the corolla. Fruit red, smooth, rather tasteless, nearly $\frac{1}{2}$ in. through, with 5 nuds.

Succeeds on dry or well-drained soil, in sun or in shade. Flowers May and June. Bears fruits through year, but mostly from August through March. Propagated by cuttings taken in late summer and rooted under glass, or by seeds sown in similar situations. May serve somewhat as a soil anchor on otherwise sterile soil.

Raw berries mealy but nourishing. Cooked berries better. Reported to have some medicinal value, since it contains arbutin, ercolin, ursone, tannic acid, and gallic acid used as urinary antiseptic, astringent, and diuretic. Eaten by grouse, turkey, deer, bear, and sheep but considered of little value as a browse for domestic livestock of any sort.

Manzanita

Arctostaphylos manzanita

Shrub. Upright. Height to 13 ft. Branches widely spreading, with branchlets finely fuzzy or smooth. Leaves evergreen, entire, smooth or nearly so except when young, dull green, more or less blunt or with a short point, to 2 in. long, petioled, rather broadly egg-shaped.

Ranges from Oregon through California, particularly in the humid regions to the west of the mountains and near the sea. Related woolly manzanita *A. tomentosa* has wider range extending down into Arizona and New Mexico. Its leaves are not smooth. Nearly 40 species of *Arctostaphylos* spoken of collectively as manzanitas.

Flowers in dense clusters over 1 in. long and for most part smooth, white or pink, with corolla to $\frac{1}{4}$ in. long, showy in spring and fragrant. Fruit to $\frac{1}{2}$ in. through, like a sphere, flattened from the top, reddish-brown and smooth.

A relatively common chaparral shrub. Within its range, conspicuous because of branching and reddish branches. While most reproduce by root shoots, this species is easily killed by fire and does not crown-sprout. Relatively slow-growing, doing best on dry, well-drained soil in a humid atmosphere but exposed to sun.

A most important honey plant within its range. Fruits available the year round. May make an important food for game birds such as sharp-tailed grouse and dusky grouse. Seeds sown in spring after stratification in moist sand at from 41–50°F. Of little value as forage for cattle but will be eaten by goats and some sheep.

Madroña

Arbutus menziesii

Tree. Height to 125 ft. Trunk usually tall, straight, and to 5 ft. in diameter. Branches stout, spreading or upright. Slender branchlets light red, pea green, or orange, smooth when young, becoming reddish-brown by first winter. Leaves dark-green above and white beneath, evergreen, to 5 in. long and 3 in. wide, thick.

From British Columbia through Washington and Oregon into northern California, with *A. arizonica* extending range into Mexico and *A. texana* extending it into Texas. *A. menziesii* is occasionally grown in gardens in western and in southern Europe; is probably best known species generally. Does well on a variety of soils. About 12 species in all.

Flowers in relatively few-flowered clusters arranged along terminal stems beyond the leaves, each flower being about $\frac{1}{4}$ in. long and whole cluster being to 6 in. long. In *A. menziesii* and in *A. arizonica*, the ovary is smooth; in *A. texana*, it is fuzzy. Fruit orange-red, fleshy, to $\frac{1}{2}$ in. long, with several angled dark-brown seeds.

Flowers March and May. Fruits available from July through January. About 30 seeds per berry and 1,000 useful plants from 1 lb. of seed. Difficult to transplant. Wood heavy, hard, close-grained, light brown shaded with red, with lighter colored sapwood of to 12 annual rings thickness. Stumps sprout abundantly.

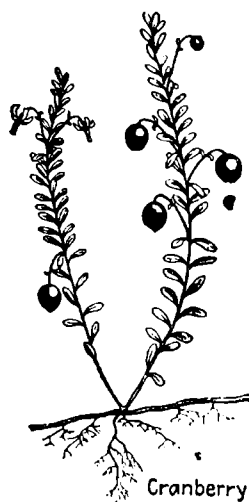
Wood used commercially for furniture and charcoal. Bark used as source of tanning material. Nectar of flowers an excellent source of honey. Tree a thing of beauty. Fruits eaten by doves, pigeons, turkeys, raccoons, and ring-tailed cats. Leaves browsed by deer, goats, sheep, and cattle. Whole plant serves as a soil anchor.



Black
Huckleberry



High Bush Huckleberry



Cranberry

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Ericales. Family Ericaceae

High-bush Huckleberry
Gaylussacia baccata

Shrub. Height to 3 ft. Erect, with gray forked branches that are usually fuzzy when young. Leaves entire; when young, very resinous; alternate, smooth or nearly so, rather stiff, to 2 in. long, rather uniformly green on both sides, not evergreen, short-petioled.

Native of North America ranging from Newfoundland to Florida, west to Manitoba, with closely related species extending range considerably. In America, about 40 species in genus, most of which are valuable because of their delicious fruits.

Flowers relatively few to a cluster, clusters being at ends of short spurs arising from ends of branchlets or from below ends, in 1-sided clusters, pink or reddish, with 5-angled corolla that is much longer than calyx and to $\frac{3}{4}$ in. long. Fruit black or blue, with or without a bloom but sometimes white, to $\frac{3}{4}$ in. through.

Flowers May and June. Bears fruits in July and August. Fruits rather seedy but very sweet. Soils favored are sandy or distinctly acid. Some persons consider fruits to be poisonous, but there is no basis for this except that berries resemble those of the puckery but not poisonous chokeberry, *Pyrus arbutifolia*.

Leaves feel sticky when pinched, due in part to yellow-brown resin or varnish they contain. Fruits are much more tasty than more abundant and smaller blueberries though they contain more conspicuous seeds that make them somewhat unpleasant. Known as crackers, black snap, and black huckleberry. Excellent food for wildlife.

High-bush Blueberry
Vaccinium corymbosum

Shrub. Profusely branched. Height to 15 ft. Twigs round in cross section, finely warty, commonly but not always smooth. Leaves to 3 in. long and to $1\frac{1}{2}$ in. wide, alternate, entire, not evergreen, green and smooth above and lighter green and sometimes slightly fuzzy beneath, short-petioled.

Native of North America. Ranges from Quebec to Virginia, west to Louisiana and Minnesota, with closely related species extending range on to the Pacific Coast and with other closely related species extending range to the north. Found in swamps and in woodlands.

Flowers borne at time leaves appear, in short clusters of relatively few flowers, the flowers being equal to or longer than immediate stems that bear them; white, or sometimes faintly pink, cylindrical, with throat slightly narrower, to $\frac{1}{2}$ in. long and $\frac{1}{4}$ in. through. Fruit blue, with a bloom, to $\frac{1}{2}$ or more inches through.

Flowers May and June. Fruits July through August, generally recognized as a later form than *V. pennsylvanicum*. Produces abundant suckers. Plants are easily divided and survive transplanting well. May be easily propagated by means of cuttings and therefore lends itself to cultivation practices.

Valuable commercial blueberry used for late-season market. Fruits sold fresh, preserved for use in pies, or made into jams and jellies. Wild fruits provide a superior food for most species of game birds and particularly for ruffed grouse, ring-necked pheasant, and mourning dove; also for cottontail rabbits.

Cranberry
Vaccinium oxycoccus

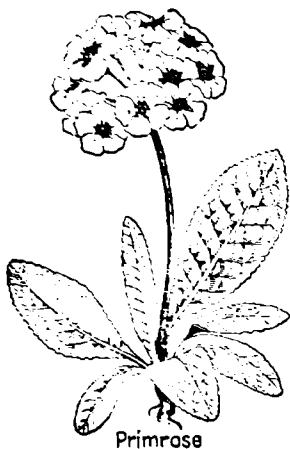
Slender, creeping, woody, vine-like plant that roots at joints and has stems to $1\frac{1}{2}$ ft. long and a number of branches. Leaves alternate, evergreen, thick, entire, dark-green above and light beneath, to $\frac{3}{4}$ in. long and nearly $\frac{1}{2}$ as wide, with margins curved downward and inward. Root system extensive and, like stems, long and spreading.

Native of Old World and of New World. Found in Asia and Europe as well as in North America. Found in cold peatbog formations from Newfoundland to North Carolina, west to Washington and Alaska but grown under cultivation in some parts outside natural range. Differs from American cranberry in having spherical rather than oblong fruits.

Flowers nodding pink bells, up to 6 on a branch, arising from terminal shoots, about $\frac{1}{8}$ in. across, with parts divided to near base and recurved conspicuously, with filaments of stamens $\frac{1}{2}$ length of anthers. Fruit red spheres, to $\frac{1}{2}$ in. in diameter in wild form or larger under cultivation; tart, sometimes spotted.

Flowers May through July. Bears fruits that are at best through August and September but may persist through winter, keeping well in spite of severe weather. Common market cranberry is *V. macrocarpon*. Berries may require much sugar but a teaspoonful of salt may equal a cupful of sugar in counteracting sourness.

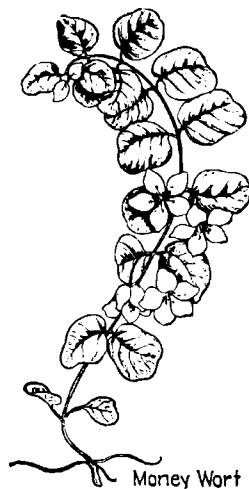
Highly valuable in making cranberry sauce, a Thanksgiving essential, cranberry pie, and in jellies, jams, and drinks. Mixed with gelatin or white of egg, makes an excellent desert or may be made into a mock cherry pie. The industry of raising and marketing cranberries is an important one. Known as sourberry, moss melons, crowberry, moorberry.



Primrose



Whorled Loosetrife



Money Wort

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Primulales. Family Primulaceae

Early Garden Primrose

Primula polyantha

Herb. Hardy, usually in rosette form. Height to about 1 ft. though usually less. Leaves narrowed into a long-winged petiole, rather conspicuously wrinkled, with uneven margins, about 6 in. long and about $\frac{1}{3}$ as wide, bluntly pointed at free end, prominently veined.

Probably a hybrid of a number of species including *P. acaulis*, *P. veris*, and *P. elatior* or *P. vulgaris*. By some, the whole group of garden primroses of which this is one is called *P. variabilis*. Since it is a hybrid, its geographical origins are probably widespread. This is grown commonly in borders, in greenhouses, and in houses.

Flowers borne in clusters like umbels at top of flowering stem though in some garden primroses single flowers are borne close to ground. Flowers single or double, maroon, orange, bronze, white, red, yellow, or of mixed colors, sometimes with center differently colored from outer areas.

Usually propagated by sowing seeds as soon as they are ripe or by division of plant itself. Seeds sown in greenhouse from February to May may yield flowers by Christmas. Best soil is mixture of half leaf mold and half sand. Plants should be kept cool. Some species, like *P. obconica*, may cause a dermatitis to some persons.

Seedlings with 3 leaves transplanted into 2½-in. pots with loam and rotted manure, with crowns at ground surface. In August, reset in 6-in. pots with rich fertilizer. In September, plants returned to greenhouse and kept at 45°F., to be raised when flowering needs to be stimulated. *P. malacoides* is grown to be sold as a cut flower.

Whorled Loosetrife

Lysimachia quadrifolia

Herb. Height to 3 ft. Smooth, slender, little branched, erect. Leaves in whorls of 3-7, but usually of 4-5, or sometimes a few are simply opposite, without petioles, to 4 in. long and to 1½ in. wide, usually bearing small black dots, entire, rather prominently veined, pointed at each end or more blunt at base.

Native of North America. Ranges from New Brunswick to Georgia, west to Tennessee and Wisconsin. Found for most part in shady thickets or in relatively open woodlands. About 70 species of the genus found mostly in Northern Hemisphere but some are found in Africa and Australia.

Flowers borne in axils of leaves, on rather long slender erect or drooping stems, to 1½ in. long. Flowers to ½ in. broad, yellow, with dark spots or streaks, smooth. Sepals pointed, slender, with filaments fastened together at base. Fruit a capsule that is about length of calyx lobes.

Flowers appear from June through August. Pollination effected by honeybees, bumblebees, and bees of the genus *Macropis*. Their visits are necessary to produce pollination since stamens are too short to reach pistil otherwise. Plants do well on sandy soil or on moist ground.

Of no considerable importance economically but a rather attractive flower when growing in its natural setting. It has little beauty if picked and apparently no medicinal or food values have been recognized.

Moneywort

Lysimachia nummularia

Sprawling herb. With stems to 2 ft. long that frequently take root at joints where they touch ground, smooth, light green. Leaves opposite, the pairs being about equal, to 1 in. long, with short petioles, blunt at both ends or heart-shaped at base, with some small black dots scattered over surface.

Found on wet grounds in shade or in sun. From Newfoundland to Virginia, west to Illinois and Michigan or farther. Native of Europe but now well-established here. Most of other lysimachias are erect, slender plants not easily confused with this prostrate sprawler.

Flowers borne in axils of leaves, individual, yellow, deeply 5-lobed, with calyx half as long as corolla. Stamens fastened together at bases. Fruit much shorter than calyx lobes and practically hidden by them at maturity. Many small seeds to each fruit.

Flowering time June through September or later. Fruiting time still later of course. Plant easily established by division or by cuttings and maintains itself without trouble in suitable environments. It persists in gardens, lawns, or on waste soil particularly if there is sufficiently moisture.

Popular in hanging baskets or as a quick filler in garden space but must be kept under control. It can be eliminated by digging it out, by raking, by close mowing, or by spraying with a solution of sodium chlorate. Possibly it does serve as a soil anchor. It may survive complete submergence for a considerable time.



Fringed Loosestrife



Persimmon



Privet

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Primulales

Family Primulaceae

Fringed Loosestrife

Steironema ciliatum

Herb with erect, slender stems, much-branched, mostly smooth but with rows of hairs on certain parts. Height to 4 ft. Leaves thin, membranous, opposite, to 6 in. long and to 3 in. wide, on petioles to $\frac{1}{2}$ in. long, these being definitely hairy, often with clusters of small leaves at bases of normally sized leaves.

Naturalized from Europe but well-established in North America. Ranges from Nova Scotia to Georgia, west to Arizona and British Columbia, with related species extending the range. At least 5 species native of North America. This species ascends to elevations of 6,300 ft. in North Carolina.

Flowers erect, spreading or nodding, singly from axils of leaves, yellow, to 1 in. across. Corolla of 5 parts. Calyx of 5 parts that are shorter and narrower than petals. Stamens, 5, with distinct filaments and slender anthers. Fruit a capsule, conspicuously longer than calyx lobes that persist. Seeds angular.

Name refers to presence of some stamens in flowers that are without anthers and to hairy petioles. Flowering time June through August. A rather conspicuous terra-cotta-colored ring about the center of the otherwise pure yellow corolla. Plant is apparently of no importance medicinally.

An interesting, inconspicuous plant that rarely if ever could become obnoxious as a weed. Attractive flowers do not survive picking, and are not large when compared with extent of foliage.

Family Ebenaceae

Persimmon

Diospyros virginiana

Tree. Height to 100 ft. Trunk diameter to 2 ft. Bark to 1 in. thick, dark-brown with a tinge of red or gray, deeply checkered into squares. Winter buds to $\frac{1}{4}$ in. long, with lustrous scales. Leaves alternate, entire, taper-pointed, petioled, to 5 in. long, dark-green above and pale beneath, smooth when mature.

Native of North America. Found in fields and woodlands. Ranges from Connecticut to Florida, west to Kansas and Texas. One other tree of the genus in North America, *D. texana* or chapote, ranges from Texas to Southern California. About 160 species in the genus, mostly native of Asia.

Flowers borne singly or in small clusters in axils of leaves, mostly 4-parted; with greenish-yellow corolla and with stamens and pistils in separate flowers, the pistillate usually being solitary and the staminate in clusters. Pistillate flowers to $\frac{1}{2}$ in. long and about twice the size of staminate. Fruit to 1 in. through, reddish-yellow.

Flowers May and June. Fruits September through November; become sweet when completely mature after a frost but are astringent when they are green. Wood hard and brown, weighing to 40 lb. per cu. ft., with nearly black heartwood. Leaves reported to be high in vitamin C.

Wood used in wood turning, shoe lasts, and for shuttles. Fruits eaten raw when ripe, or made into jellies, sirups coffee substitutes, tea, vinegar, or beer. Coffee is made by roasting the seeds, but Indians made flour for bread from the seeds. Known as Jove's fruit, possumwood, winter plum, date plum, lotus tree, and seeded plum.

Order Gentianales

Family Oleaceae

Privet

Ligustrum vulgare

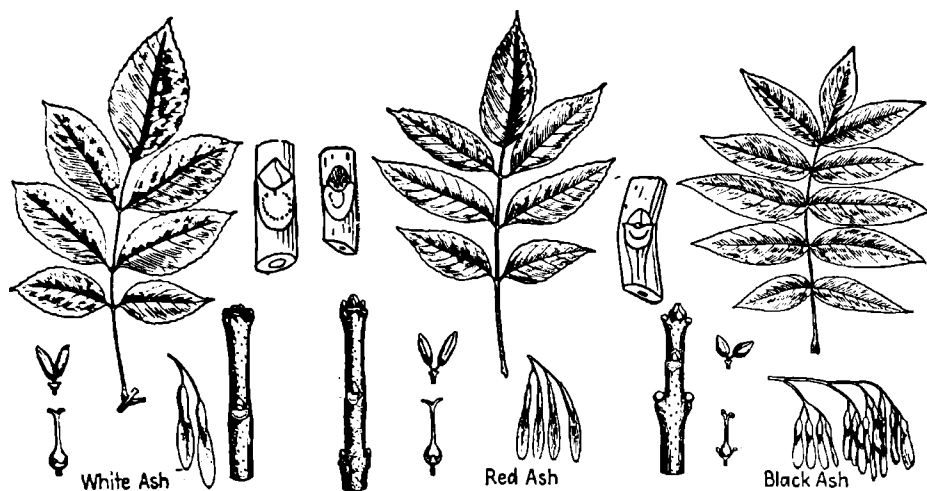
Shrub. Height to over 15 ft. Freely branched, particularly if pruning has been severe. May form a dense impenetrable hedge. Twigs dark and finely fuzzy. Leaves opposite, smooth, dark-green above and lighter beneath, short-petioled, to 3 in. or more long, with margins practically entire. Root system spreading and sometimes giving rise to shoots.

Native of Europe, Africa, and Asia. Naturalized in many parts of the world and not uncommon in remote places where plants may have been started by seeds carried by birds. One of commonest of hedge plants in eastern United States, where a well-trimmed privet hedge is evidence of pride in the home.

Flowers borne in rather dense terminal clusters, to 3 in. long, somewhat pyramid-shaped. Individual flowers white or greenish-white, small, with a funnel-shaped corolla that is longer than calyx, which is 4-parted and with 2 stamens. Fruit a blue-black, 2-celled, 1-2-seeded berry that persists through winter.

Flowering time June through July. Fruits first available about September. About 13,000 seeds per lb. Propagation by means of seeds, by division of root system, or by simple cuttings thrust into ground and rooting if the soil is wet enough. Plant does well in dry well-drained soil, preferably in the sun.

Primarily of importance as a hedge plant and ornamental and because of its hardiness will withstand considerable neglect or abuse. Fruits eaten by a number of wild birds and are reported in southern Michigan as an important food for pheasants. Horses have been poisoned by browsing on leaves. European children have been killed by eating fruits.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Gentianales. Family Oleaceae

White Ash
Fraxinus americana

Height to 120 ft. Tall, open, straight, egg-shaped, with relatively coarse branches standing more or less horizontally. Trunk to 6 ft. in diameter. Roots shallow. Twigs coarse, smooth, straight, with broad, crescent leaf scars, and bundle scars in curved line. Buds round, brown to black. Leaves to 12 in. long, compound, of to 9 stalked leaflets, whitish beneath.

Found on rich hillsides, in mixed forests rather than in pure stands. From Minnesota to Nova Scotia, south to Florida, eastern Texas, and Kansas but planted outside normal range for one reason or another. Commonly associated with maples, oaks, and birches. Does not thrive in low, wet lands on which black ash does so well.

Flowers appear before leaves, staminate appearing as close clusters on one tree while pistillate are in loose open clusters on another. Pollination by wind. Fruits winged samaras, from $\frac{3}{4}$ -2 in. long, with seed at one end; wing almost wholly terminal and seed portion almost round in cross section. Fruits 8,000 per lb., with 35-50% germination.

Wood light brown, tough, strong, heavy, hard, with thick, lighter colored sapwood; used in making tool handles, oars, furniture, boats, carriages, and the like. Fruits collected in September to December are buried in sand, planted in spring at $\frac{1}{2}$ -in. depth. Seedlings reach to 9 in. in 1 year, to 6 ft. in third season. Stumps sprout to 5 ft. first year.

Fine timber tree where conditions are suitable and often trunks rise straight and uniform to surprising heights. Tree is sometimes used as a shade tree but compound leaves produce an untidy trash that makes it unpopular. Wood makes superior fuel and commercial wood. Secretes manna, mannetol, or manna sugar (not a true sugar, though sweet).

Red Ash
Fraxinus pennsylvanica

Tree. Height to 60 ft. Trunk diameter to 2 ft. Compact, irregular head, with slender twigs that are round in cross section, conspicuously fuzzy, and with semicircular leaf scars. Leaves compound, of 5-9 leaflets, each to 6 in. long and to 2 in. wide, green on both sides, petioled, and sharp-pointed.

Native of North America. Found mostly in swamps and wet places from New Brunswick to Florida, west to Minnesota and Texas. Grown somewhat outside its normal range as an ornamental or for other reasons. About 50 species of the genus found mostly in north temperate regions; over 20 in North America.

Flowers: staminate and pistillate on separate trees, appearing late in spring about as leaves begin to appear. Each staminate flower has 2 stamens; each pistillate flower appears like a deeply divided cup. Fruit borne in an open, smooth cluster, winged, with wing extending to about middle of fruit body.

Wood weighs to 44 lb. per cu. ft., strong, brown, tough, and split in spring into splendid material for making baskets and cane seats. Grows rapidly when young but slower when mature, with about 11,000 seeds per lb. having 50% germination; green ash yields 3,000 usable plants per pound of seed.

Wood used extensively in basketry but on whole less important than that of white ash. Rarely attacked by fungi or by insects. Seedlings reach height of 4 in. first year. Plants in one condition or another provide food for a number of birds and deer, rabbits, and hares. Known as water ash, river ash, swamp ash.

Black Ash
Fraxinus nigra

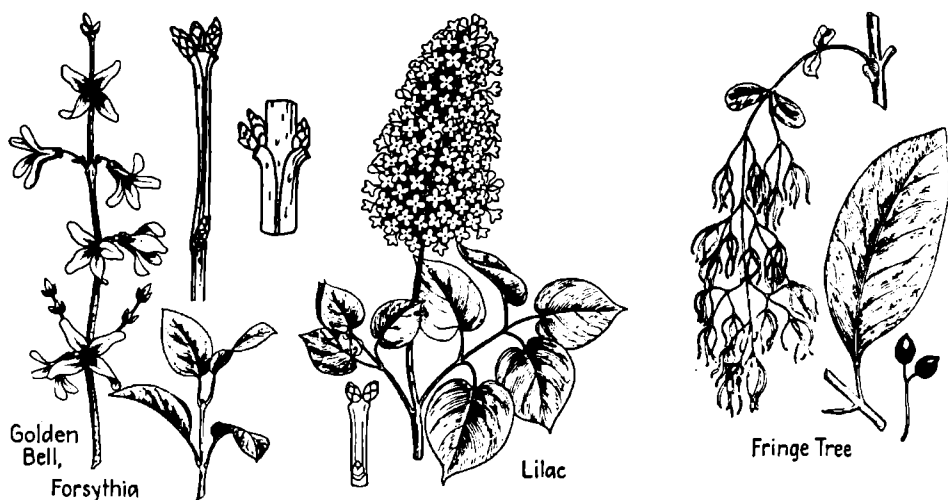
Tree. Height to 100 ft. Trunk diameter to 2 ft. Bark ash gray, without deep ridges but with thin scales. Twigs smooth, dull, with black buds and circular or semicircular leaf scars. Leaves opposite, compound, of 7-11 leaflets, each to 6 in. long and to $1\frac{1}{2}$ in. wide, stalkless and with rounded bases.

Native of North America. Found in wet woods and swamps and planted along streets. From Newfoundland to Virginia, west to Arkansas and Manitoba. Differs from other ashes of its territory in presence of black buds, leaflets without petioles, and because fruit wing extends all around the "seeds."

Flowers: staminate and pistillate on separate trees, or sometimes on same tree, purple, calyx absent, appear in May or about same time as leaves. Fruit winged, to $1\frac{1}{2}$ in. long, with wing running all way around "seed" but at one end just the same, carried by wind and shed in fall.

Wood weighs to 39 lb. per cu. ft., soft, weak, dark-brown. Root system conspicuously shallow. Tree easily overturned by wind, easily damaged by fire but avoided by fungi and insects. Seeds weigh 3,000 per lb. and have low vitality. Spring cankerworm may attack leaves; ash wood borer, the lumber.

Used as a shade tree and ornamental. Wood used in interior finish, in cabinet work and in making barrel hoops and baskets. Also generally makes a good firewood. Does not succeed as a hedge plant. Cottontail rabbits feed on bark and leaves and evening grosbeaks on fruits in winter.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Gentianales. Family Oleaceae

Golden Bell
Forsythia viridissima

Shrub. Height to 10 ft. Branches erect or in graceful arches. Twigs remarkably uniform in diameter for long distances, ridged, yellow-brown. Buds clustered at joints. Leaves opposite, to 6 in. long and to about $\frac{1}{2}$ that width, tapering at each end, entire or irregularly notched above middle.

Native of China. Widely grown as an ornamental in temperate parts of world. One of most popular of hedge plants. Of 4 species that originate in China, Japan, and southeastern Europe, *F. suspensa* has hollow branches, this species has generally erect branches, and *F. intermedia* has conspicuously arched branches.

Flowers bright greenish-yellow, with 1-5 in axils of leaves, with a 4-parted calyx and a deeply 4-parted corolla that in this species is less likely to open widely than in *F. intermedia*, with 2 stamens fastened to inside of corolla tube. Fruit, a woody capsule that splits to free many winged seeds.

Flowers appear before leaves; are to 1 in. long and spectacular. Easily propagated by using cuttings of fresh green wood, or by layering drooping branches, or by use of seeds. If undisturbed, drooping branches may themselves take root and plant may thus occupy considerable space.

One of most valuable and popular of hedge plants because of beauty of flowers in early spring, dense thicket formed by branches, and clean appearance of dark-green leaves. Winter twigs bearing flower buds may be made to produce flowers by bringing them into the house early. May flower in fall.

Lilac
Syringa vulgaris

Tree or shrub. Height to 20 ft. or more. Rather profusely branched, smooth, with light gray bark. Usually 2 buds at ends of twigs. Leaves opposite, to 4 in. long and $\frac{3}{4}$ that width, somewhat egg-shaped but pointed at tip, usually bright green, thin, not evergreen, heart-shaped at base.

Native of eastern Europe but widely grown as an ornamental and so hardy that it survives in homesteads long after other evidence may have vanished. One of commonest of ornamentals in old-fashioned gardens. May escape from cultivation. About 30 species native of Europe and Asia, but widely grown.

Flowers lilac or white and well-known, most fragrant, borne in rather compact clusters that may be 8 in. or more long, with individual flowers about $\frac{1}{4}$ in. long. Calyx and corolla both in 4 parts. Stamens 2, fastened to inside of corolla tube. Fruit a dry somewhat woody capsule, to $\frac{3}{4}$ in. long, splitting to free seeds.

Flowers April or May; may persist until early June. May be forced by bringing plants into greenhouse and holding at temperatures of about 60°F. for a few days then to 88°F., increasing gradually while clusters develop, then lowering to 66° when first flowers open. Many forcing tricks developed by gardeners.

Valuable plant for greenhouse, for use as cut flowers or as house plants, or possibly more valuable as a "friendly" sort of hedge ornamental, particularly if lower areas can be filled in with some low species. Leaves in summer are commonly covered with a powdery mildew that does no particular harm. State flower of New Hampshire.

Fringe Tree
Choisanthus virginica

Tree or shrub. Height to 30 ft. or more. Trunk diameter to 10 in. Branches stout, ashy to brown, forming an oblong head. Bark to $\frac{1}{2}$ in. thick, with small thin brown scales tinged with red. Leaves opposite, to 8 in. long and to 4 in. wide, thick, firm, dark-green above and paler beneath, yellow in fall.

Native of North America. Found ranging from Pennsylvania to Florida, west to Texas, Oklahoma, and Arkansas. 3 species in the genus native of North America and China, of which this one may be rather commonly planted as an ornamental particularly in eastern United States and western Europe.

Flowers white, appear when leaves are about $\frac{1}{2}$ grown, in long drooping open clusters that are to 6 in. long and lengthen in early summer to make the fringe. Each flower to about 1 in. long, slightly fragrant; some flowers with both stamens and pistils, but sometimes these elements are on different trees.

Fruits ripen in September, are like dark-blue to black stone fruits, to $\frac{3}{4}$ in. long, with a bloom that may be rubbed off. Plants do best in moist sandy soil in sun. Propagation by grafting onto ash seedlings, by layering, by cuttings, or by seeds sown in fall in layers of sand and transplanted as seedlings.

An ornamental with limited and local popularity. About 2,000 seeds per lb. They are not listed as being commonly eaten by wildlife. They have been found in the stomachs of pileated woodpeckers. May thrive on soils sourer than those usual for most trees and shrubs.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Gentianales

Family Gentianaceae

Fringed Gentian

Gentiana crinita

Annual or biennial. Height to 3½ ft. Erect, relatively slender, somewhat 4-angled stems. Leaves opposite or approximately so, lower ones being widest toward tip, and upper, widest near base; smooth, entire, to 2 in. long; upper leaves with clasping bases.

Found about springs or in moist meadows and woodlands. From Quebec to Georgia, west to Iowa and Dakota, though it has been destroyed by collectors over much of its range, particularly near centers of population. Considered one of the rarest of the desirable wild flowers.

Flowers, several, borne at tips of terminal branches. Calyx unequally 4-cleft, with sections as long as tube of corolla. Corolla a delicate blue or white, to over 2 in. long, spreading at tip, with petal lobes beautifully fringed all around the edge. Fruit spindle-shaped. Seeds numerous, scaly.

Reproduction by seeds only, therefore promiscuous and extensive collection of the flowers easily leads to plant's extinction. Remaining stations in an area should be closed to collectors. Fortunately, the plant can persist once it is established but it is very difficult to establish. Seeds do not survive drying.

This is the plant about which Bryant wrote:

"Blue—blue—as if that sky let fall
A flower from its cerulean wall."

The flowers are open only when the sun is shining and close tightly in the shade. For this reason if for no other they are at their best in their natural setting.

Periwinkle

Vinca minor

Trailing stems. From 6 in. to 2 ft. long. Perennial. Leaves opposite, evergreen, green on both sides, entire, short-petioled, to 2½ in. long and to 1 in. wide, firm, narrowed at base, distinctly glossy. Stems root rather freely at joints to form a dense mat that usually excludes competition.

Introduced from Europe but firmly established in America where it was grown by early settlers. Often at its best in old cemeteries or on abandoned homesites. Grown as a border plant in gardens and found from New England to Georgia and westward.

Flowers usually borne singly in axils of leaves, not too abundant on a given stem, but massed may appear to be so, blue, with wide spreading lobes making whole flower to over 1 in. across. Calyx lobes deeply parted, smooth, green. Stamens with anthers connected. Fruits slender, few-seeded, splitting freely when mature.

Easily propagated by division of horizontal rooted stems. These are merely buried lightly in soil. A clump of plants every foot or so in newly graded, relatively shaded soil may spread to cover the whole surface to the exclusion of other species, particularly if weeding is carried on for the first year or so.

Justly popular as a ground cover for steep banks and for areas where shade is too deep to support many other species. Flowers February through May. Shining leaves present throughout the year. Ability to form a pure stand makes it attractive and a good soil anchor. Used in erosion control.

Family Apocynaceae

Spreading Dogbane

Apocynum androsaemifolium

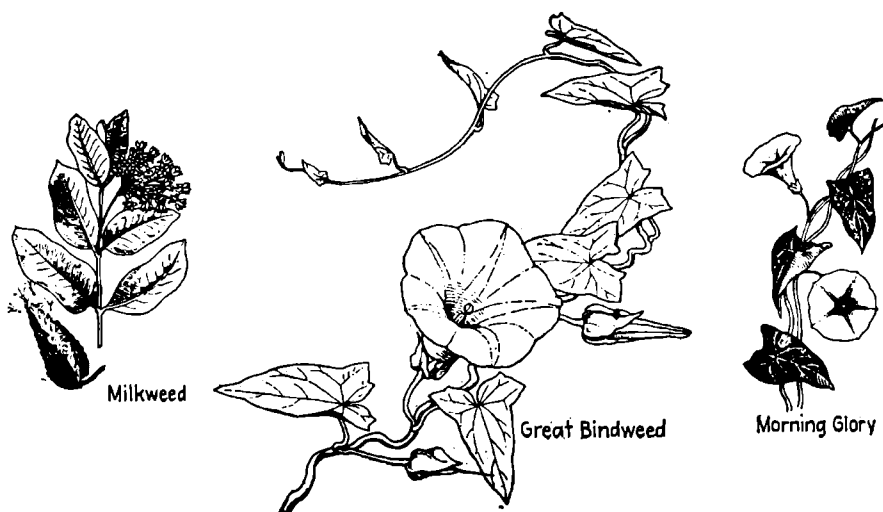
Height to 4 ft. Branched, freely spreading, smooth, tough-barked. Leaves to 4 in. long and to 2½ in. wide, opposite, smooth above but pale and somewhat fuzzy beneath, with a short blunt point at tip, milky-juiced. Rootstock substantial, horizontal, buried, perennial, spreading.

Found in waste fields, thickets, and flood plains. From Anticosti Island to Georgia, west to Arizona and British Columbia, reaching an elevation of 3,500 ft. in Virginia. Related *A. cannabinum*, Indian hemp, has more closed flowers and narrower, more distinctly petioled leaves. 11 species, mostly found in temperate North America.

Flowers pink, like bells opened suddenly and widely, somewhat angled, to ½ in. long, with calyx tube considerably shorter than tube of corolla as contrasted with longer calyx in *A. cannabinum* where it about equals corolla tube. Fruit a pair of slender inward-curving pods that burst to free many seeds.

Flowers June through July. Pollinated by bees and butterflies. Visited intensively by the metallic red and green dogbane beetle, *Chrysobothris auratus*. From 15–30 gm. of green leaves may cause death of a cow or horse following symptoms of dilated pupils, sore discolored mouth, sweating, and fasting.

Poisonous principle is the glucoside cymarin, a poisonous resin, and probably other elements. A crude fiber made from the bark. Milky juice has been considered a possible source of rubber. Young plants eaten by cattle are emetic and cathartic in their effect. Known sometimes as "Indian hemp."



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Gentianales Family Asclepiadaceae

Common Milkweed

Asclepias syriaca

Height to 5 ft. Stem stout, usually unbranched, tough-barked, often fuzzy in upper parts. Leaves opposite, to 9 in. long and to 4 in. wide, dark-green above and lighter beneath, with main veins widely spreading and conspicuous, petioles stout. Root system to 15 ft. long, just under surface.

Native. Found in fields, along roadsides, in waste places, and sometimes in gardens. From New Brunswick to North Carolina and west to Kansas and Saskatchewan. A few varieties are recognized, based on differences in leaves, in flower clusters, and in flowers. Has been sparingly cultivated for experimental purposes.

Flowers borne in many-flowered ball-like clusters in axils of upper leaves in umbels; from pale brown to lilac, dull crimson pink to lilac pink, with a greenish 5-parted calyx, rather fragrant, abundantly visited by bees, flies, and butterflies, with anthers free to be torn loose by visiting insects.

Survives dry wasteland. Young shoots eaten raw or cooked, although considered to be poisonous by some persons, are delicious when eaten with spearmint as a sandwich. Cattle and sheep have been seriously poisoned by eating mature plants. Pods stout, to 4 in. long, open to free many parachuted seeds sometimes throughout the winter.

Bark makes an excellent fiber substitute, fluff of seeds used in making life preservers in World War II, milky juice used in search for rubber source, root used in medicine of a homely type, root system serves as soil anchor. Plant is host of beautiful monarch butterfly. Can be kept under control by cultivation and by salting.

Great Bindweed

Convolvulus sepium

Stems trailing, twining, and climbing, often to length of over 10 ft., sometime slightly fuzzy or more commonly smooth. Leaves alternate, gray-green, darker above, slender petioled, with triangular or arrow-shaped blade to 5 in. long. Root system of slender light-colored rootstocks.

Native. Found in fields and thickets from Newfoundland to North Carolina, west to New Mexico and British Columbia. Some 200 species found in temperate and tropical areas, with 30-40 in the United States. Small bindweed, *C. arvensis*, and others are bad weeds in some areas.

Flowers borne singly in axils of leaves, on stalks about equal in length to the flower that is about 2 in. long, white or pink, with white stripes, funnel-shaped, with widely spreading edge. Calyx has 2 large enclosing bracts that are absent in smaller flowered *C. arvensis*. Fruit a dry spherical capsule.

Flowers may be cross-pollinated by honeybees or bumblebees or may be self-pollinated. They usually close before noon much as do morning-glories. Flowers June through August. *C. arvensis* has root system that may reach 15 ft. underground and is therefore difficult to destroy by ordinary cultivation methods.

Ordinary control of bindweeds is by frequent cultivation at 6-day intervals, cutting the plants to depth of 6 in. followed by planting of dense shade crop like millet, sorghum, or alfalfa; or may be covered with paper or heavy straw mulch; or sprayed with arsenical sprays, sodium chlorate, or other weed sprays.

Order Polemoniales Family Convolvulaceae

Common Morning-glory

Ipomoea purpurea

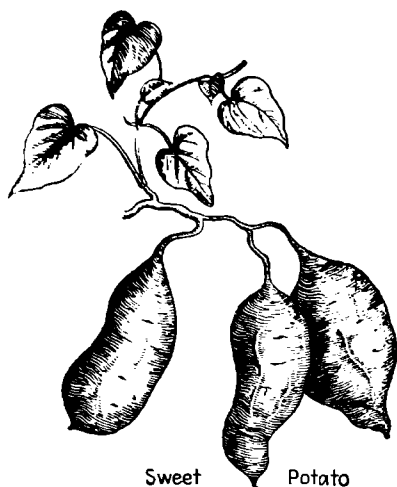
Annual. Long, trailing stems binding their supports and reaching to 10 ft. in height, relatively slender and weak. Leaves to 5 in. long, dark-green above and lighter beneath, broadly heart-shaped at base, short-pointed at tip, entire, with petioles about equal to blades in length.

Native of tropical America but grown extensively to north and generally in gardens and in temperate regions where it may reseed itself and become weakly established. Over 400 known species from various tropical parts of the world. Many races and varieties, some horticultural in nature due to crossings.

Flowers showy, wide-lipped funnels, variously and usually brilliantly colored, opening in morning sun, with tube usually lighter colored than other parts, to 3 in. long, with stamens and pistils usually shorter than tube and stigma sticking above anthers. Fruit, a dry capsule.

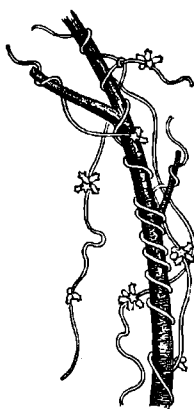
Many double-flowered forms have been developed. Used frequently in making studies in genetics because of conspicuous life cycle and fact that plants may be grown in pots easily in house or greenhouse.

A popular, old-fashioned-garden flower. Figure shown above does not show typical *I. purpurea* leaves, these being broadly heart-shaped rather than triangular as shown. Related *I. pandurata*, man-of-the-earth, yields roots weighing to 30 lb. and edible when roasted. *I. purga* of the tropics is poisonous.



Sweet

Potato



Dodder



Moss Pink

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales

Family Convolvulaceae

Sweet Potato

Ipomoea batatas

Stems many feet long, trailing, with thin hairs, rooting freely at joints, milky-juiced. Leaves highly variable in different parts of same plant, some being heart-shaped, some oval, and some triangular, but all rather coarse and dark-green. Root system, deep-penetrating reddish rubers.

Native of South America. Probably cultivated by native Americans thousands of years before Columbus landed. Known in China before the Christian era. Carried to Europe from the West Indies in 1526 and was grown in Virginia in 1650. Requires long warm growing season with moderate rainfall, particularly at first.

Flowers like those of the morning-glory with funnels of rose or blue, with darker instead of lighter centers, about 2 in. long, with the sepals of the green enclosing calyx each about $\frac{1}{2}$ in. long. Seeds angular, smooth, dark, enclosed in a fragile spherical fruit that breaks readily.

Commercially cultivated by slips, by cuttings of vines, or by separation of roots. Requires 6 bushels of "seed" to set an acre though quantity varies with nature of slips. Large roots produce fewer plants per bushel of seeds than do smaller roots. Roots should be disinfected before planting to control rot.

Georgia leads in production of sweet potatoes with 80% of the United States crop usually produced in Georgia, Alabama, Louisiana, North Carolina, South Carolina, Mississippi, Tennessee, Texas, and Virginia. Improved storage and commercial drying techniques make possible a wider use of this valuable food so subject to decay.

Dodder

Cuscuta gronovii

Annual. Stems slender, yellow to orange, climbing, with haustoria that tap bundles of plants on which dodder grows, these being used not only as supports but as means of getting food. Plant is leafless and not green; therefore, must be parasitic. Contact with ground is lost at maturity.

Found growing on many kinds of plants, both herbs and woody plants. From Nova Scotia to Florida, west to Texas, Montana, and Manitoba. About 100 species of dodder, of which some 30 are found in United States either as natives or as introduced species. This species is rather widespread.

Flowers July and August, in dense clusters on short stems, with bell-shaped corolla only about $\frac{1}{10}$ in. long, with its rounded lobes about equal in length to that of tube, these alternating with short stamens that appear at corolla clefts. Fruit a dry capsule, $\frac{1}{10}$ in. through.

Mealy brown seeds, somewhat spherical. When they germinate, they develop a seedling that eventually comes in contact with a plant that may serve as a host. Then contact with the ground ceases. *C. planiflora* is a common western species introduced from Europe.

Many species attack particular plants as dodders of alfalfa, clover, hemp, onion, thyme, and hazel, though some of these may not be too particular. Hand pulling, burning of infested plants, and heavy mulches are control measures. Strict laws govern occurrence of dodder seed as impurities of imported commercial seeds.

Family Polemoniaceae

Moss Pink

Phlox subulata

Stems in tufts, from trailing, prostrate stocks, the erect stems being rarely much over 6 in. tall, and often rather profusely branched in upper regions. Leaves to nearly 1 in. long, but only about $\frac{1}{10}$ in. wide at most, pointed, persistent, slender, entire, dark or yellowish-green, spreading, in clusters at joints.

Native. Found on dry, sandy, rocky, or poor soil from New York to Florida, west to Michigan and Kentucky. Frequently grown in mass beds in flower gardens with considerable success. In West Virginia, is found to elevation of 3,500 ft. Between 40-50 species of phlox are found native in America and Asia.

Flowers pink, purple or white with a darker center, with 5 spreading lobes arising from top of a tube which is about as long as the lobes. Calyx green, with pointed lobes about $\frac{1}{2}$ total length and with whole calyx shorter than corolla tube. Fruit capsule about $\frac{1}{10}$ in. long.

An excellent ground cover for poor soil, being at its best in spring when erosion factors are at their prime. One of most popular and relatively easily grown of bedding garden flowers. Flowers April through June. Pollinated probably by bumblebees and butterflies.

A dozen or more garden varieties of this species, based on habit and color. Apparently the wild plants are buried in other vegetation in the late summer when they are not so conspicuous.



Perennial
Phlox



Heliotrope



Forget-me-not

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales

Family Polemoniaceae

Perennial Summer Phlox

Phlox maculata

Height to 3 ft. Stem slender, erect, smooth or slightly fuzzy, branched or unbranched, often marked with purple dots. Leaves opposite, smooth, firm, to 5 in. long, widest near rounded base, pointed at tip, the lower being sometimes almost linear. Perennial.

Native of moist woodlands and along streams. From Connecticut to Florida, west to Mississippi and Minnesota. Commonly grown in gardens everywhere, particularly in northern part of range where it is a usual summer garden flower. Regular garden phlox is *P. paniculata*, which has less pointed calyx teeth and blunter leaves.

Flowers borne at tops of branches in clusters of a few, but with many clusters in a given area and each cluster developed along short lateral stems. Corolla white, blue, or purple, with a tube that suddenly and widely expands. Stamens usually short and enclosed in corolla tube. Pistil longer. Fruit a capsule to $\frac{1}{2}$ in. long.

Common phloxes include annual *P. drummondii*, the early wild *P. divaricata*, the tall summer perennials, *P. maculata* and *P. paniculata*, the rock-garden *P. multiflora*, and the moss pinks *P. subulata*, all of which are popular in their particular time and places. The garden species usually need room and water.

Perennial phloxes do not normally reach their full blooming vigor until some 3 years after they have been transplanted. Old clusters may be divided every 2-3 years but this delays full blooming, so the general practice is to leave some plants for blooming while others are divided for new plantings.

Common Garden Heliotrope

Heliotropium peruvianum

Small trees, vines or shrubs in their native land. In America, best known as low shrubby plants of the garden or greenhouse. Leaves oval to oblong, with conspicuous lighter veins. In *H. peruvianum*, leaves are not narrowed at the base as they are in *H. corymbosum*. Leaves usually dark-green and roughened. Roots strong and fibrous.

Native of Peru, with upward of 250 related species in the genus, all of which are native in the warmer regions. Now widely distributed, and many are popular as border plants or in greenhouses. When grown outdoors, this species favors strong sunlight and normally rich soil.

Flowers about $\frac{1}{4}$ in. long, violet or purple, with most pleasant vanilla scent. Some forms are white-flowered. Flowers arranged in compact rather long recurved formation (cyme). Stamens short and included in tube of corolla. In *H. peruvianum* corolla is little longer than calyx; in *H. corymbosum*, it is twice as long.

May be raised from seed to blooming in 1 year if started indoors. Usually trained to trellis. While they need sunlight when grown indoors, they do not do well if temperature rises much above 45°F. in winter months. Many enemies, but temperature most serious control. Attacked by most greenhouse pests.

Heliotropium means turning to the sun, indicating sensitivity to sunlight. Popular old-fashioned-garden flower. Fragrance compensates for usual scraggly appearance of the plant. Flowers used commonly as long-lasting buttonhole bouquet.

Cultivated Forget-me-not

Myosotis sylvatica

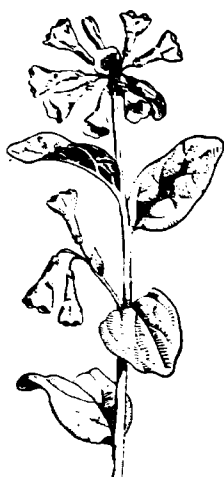
Erect or ascending stems, reaching a height of to 2 ft. but normally much lower. Green-stemmed, slightly fuzzy, much-branched. Leaves with little or no petiole rather blunt at free end and tapering at base, and, like stem, apparently hairy.

Native of Europe and northern Asia, but grown in America commonly. Frequently established in gardens and along waysides as escapes from cultivation. Some 30 or more species, of which at least a half-dozen are native of eastern United States, with fewer in western and southern parts.

Flowers borne in terminal clusters on small stems that are longer than deeply cleft calyx; whole cluster rather conspicuously loose and open. Corolla pale blue with a yellowish center, to about $\frac{1}{2}$ in. across. In some varieties, flowers are pink or white. Fruits, 4 margined nutlets.

Common garden plant used to fill in bare spaces and sometimes troublesome to keep under control. Favors shade or wet places at borders of shade. Many wild species do rather well in swamps partly submerged in water. Seeds may be sown in August and young plants given winter cover.

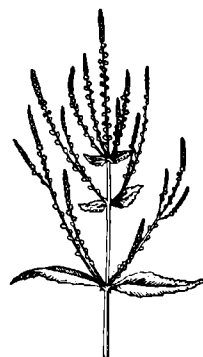
Among the recognized garden varieties are white gem, distinction, grandiflora, Victoria, perfection, and so on. Plants may be forced in greenhouses and set out in mats, or whole mats may be transplanted after the flowering time has passed.



Virginia Bluebell



Verbena



White Verbena

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales

Family Boraginaceae

Virginia Bluebell

Merensia virginica

Height to over 2 ft. Stems ascending, branched or unbranched, rather stout, smooth. Leaves alternate, smooth, pale green, to 5 in. long and $1\frac{1}{2}$ in. wide, usually more narrowed at base than at free end, with rather conspicuous veins that join inside margin, entire, rather distinctly petioled.

Native of North America, where it is found in wet woodlands and at stream margins. From Ontario to South Carolina, west to Kansas, Nebraska, and Minnesota. Sometimes grown in a wild-flower garden. Some 40 species of the genus (all of which are native to the Northern Hemisphere) in North America, Europe, and Asia.

Flowers beautiful blue bells, with relatively slender tubes that may be held erect at first but later droop, borne in loose terminal clusters, blue to purple, and showy, to 1 in. long, with the calyx short and sepals about $\frac{1}{10}$ in. long. Fruit dull, rounded, roughened nutlets.

Plants in gardens should remain undisturbed for years, not being dug up and divided as is practice with so many garden plants. Best propagated by seeds that are sown almost as soon as they are ripe. Leaves of the year disappear shortly after the flowering period, which is from March through May.

Justly popular wild-flower-garden plant. Unusual as smooth member of borage family, most species of which are extremely rough. At best when grown in masses, particularly when found in a mass growing in their natural environment. Reported by some to have a slight medicinal value but not considered authentically valuable.

Garden Verbena

Verbena hybrida

Height to 2 ft. Stems may arise from a more or less creeping base. Entire plant grayish, with long stiff spreading hairs. Leaves opposite, with margins with rounded or slightly lobed teeth, petioled, dark, with rather conspicuous veins providing attractive foliage. Roots usually tough and fibrous.

Native of Brazil. Introduced into United States in 1840. About 100 species in the genus, chiefly native of tropical America, but some are weeds in fields and waste places on either dry or wet ground north into Canada. *V. hybrida* favors rich, well-drained loam and does best when exposed to full sunlight.

Flowers in flat heads, on long floral stems, pink, blue, white, purple, or mixed, tubular, with right-angled border, slightly fragrant. Stamens, 4. Ovary, 4-celled. Fruit, dry, ribbed nutlets. Closely related *V. chamaedryfolia* has scarlet flowers and appears greenish rather than gray at a distance. Annual.

Seeds germinate in about 8 days but may live 3 years. Seedlings raised indoors in hotbeds in March, or seeds sown outdoors after danger of frost. Transplant to 1 ft. apart. Cultivate lightly, pinch back plants to improve them. Pick flowers to prolong blooming. Common enemies, thrips and aphids, controlled by nicotine sulfate.

Good for beds, window boxes, or use as cut flowers. Bright colors, fragrance, and durability make plant popular both indoors and out. Late-blooming habit helps popularity. A leaf tier pest is controlled with arsenate of lead; a red spider, with water spray, and verbena bud moth by picking off affected buds.

Family Verbenaceae

White Verbena

Verbena urticifolia

Height to 5 ft. Stems slender, erect, tough, branched, 4-sided, finely hairy. Leaves opposite, to 5 in. long and to 1 in. across, with veins joining inside saw-toothed margin, thin, rough, rather long-pointed, rounded at base, with relatively long petioles, particularly in lower ones.

Native of North America. Found in wet fields and waste places from New Brunswick to Florida, west to Texas and North Dakota. About 100 species of the genus native of the Americas, with one in Mediterranean region and nearly 30 in North America. Some are grown as ornamentals while others are serious pests.

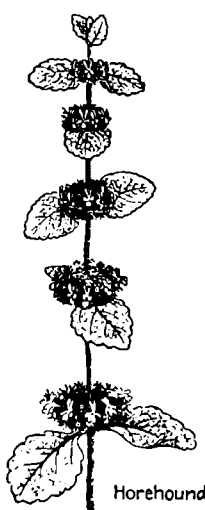
Flowers borne on slender erect spikes at tips of branches, arranged with spaces between flowers rather than crowded as in blue verbena *V. hastata* or the bracted verbena. Flowers white, about $\frac{1}{10}$ in. across, with spikes to 6 in. long. Sometimes flowers are blue or purple. Fruit oblong, brown, to $\frac{1}{10}$ in. long.

Flowering time June through September but dead tops persist through winter, providing food for birds and a persistent source of seed infection. Substantial underground parts help plants survive severe conditions but they do not survive frequent burning nor are they drought- or shade-resistant.

Control is by burning or plowing. However, in some lowlands the underground parts may provide some desirable soil anchorage. The fruits of the blue vervain are gathered by Indians of California, roasted and eaten as a bitter flour.



Lantana



Horehound



Coleus

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales

Family Verbenaceae

Lantana

Lantana camara

Height to 4 ft., or in tropics to 20 ft., where it forms a dense impenetrable thicket. Stems sometimes with short, hooked prickles; woody when old. Leaves opposite, to 6 in. long, rather thick, rough particularly above, fuzzy beneath, short-petioled, with a strong aromatic odor. Roots coarse and fibrous.

Native of tropical America but ranging wild north to Texas and southern Georgia. In most cases, plant is known from pot plants. Some 50 species, most of which are American but some are found in the Old World. In areas such as Hawaii, lantanas along paths may be impenetrable.

Flowers in round flat-topped clusters with a green bract at base of each. Flowers to $\frac{1}{2}$ in. across; heads, to 2 in. across. Usually pink or yellow at first but changing to orange or scarlet. Bud folded like an envelope. Stamens, 4. Pistil, 2-celled.

Propagation by seeds or by stem cuttings. Started usually in early summer in soil that should be not too rich. Should be exposed to the sun and temperature should be from 60-70°F. Only moderate amount of water needed. Few enemies of plant when grown in house but many including some galls affect wild plants.

Best known in temperate regions as a house plant that can withstand neglect and yet appear to be healthy and vigorous. Old plants taken from garden in late summer may be cut back vigorously, potted, and brought into the house to provide a welcome winter-blooming house plant.

Family Labiatae

Horehound

Marrubium vulgare

Height to 3 feet. Stems ascending, white, hoary, aromatic, square in cross section. Leaves opposite, rough, conspicuously veined above and woolly beneath, roundish oval, with a narrowed petiole $\frac{1}{2}$ -2 in. long, bitter-juiced. Roots perennial and fibrous.

Native of Europe but well-naturalized in America where it has long been established as a weed from Maine to North Carolina, west to California and British Columbia, being most abundant along Pacific Coast. Cultivated in America and abroad, particularly in Europe and Asia. Favors dry sandy wastelands.

Flowers crowded in dense clusters at bases of leaves, relatively small, white, with calyx bearing 10 teeth, alternating large and small and each ending in a hooked spine. Stamens, 4. Corolla, 2-lipped, the upper being erect and commonly notched. Fruit deeply 4-lobed, making nutlets.

Propagated by seeds or by division. Seeds sown in spring in cold frames are, when seedlings, transplanted to stand 6-18 in. apart in rows, the closer rows yielding finer stems and better quality. Harvesting is just before August-September flowering, yielding, when good, 1 ton of dry herb per acre, worth about 7 cents per pound.

United States normally imports about 100,000 lb. annually for use in hot-water infusions and in lozenges for treatments of colds, rheumatism, dyspepsia, and other troubles. In large doses, it acts as a purgative and in this connection is used in treatment for worms. Not recognized as an official drug. Used much in candy.

Coleus

Coleus blumei

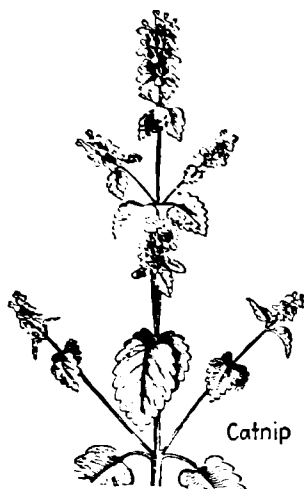
Herb or semishrub. Height to 3 ft. Branched or unbranched stems that are weak and square in cross section. Leaves of various shapes and colors, opposite, nearly regularly toothed, the teeth being rounded; variously and conspicuously colored with yellow, purple or red. Roots fibrous.

Native of Java, though average greenhouse plant may have been developed from many stocks. Common crisped-leaved form is variety *verschaffeltii*; has more brilliantly colored and denser foliage. Related forms come from India and from Africa. Important varieties have red and yellow or yellow and green leaves. About 90 species.

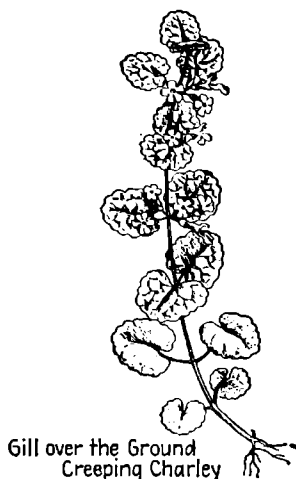
Flowers in long terminal blue or whitish clusters like spikes. Calyx small and green, 5-toothed, persistent after corolla is shed. Corolla 2-lipped, with the lower the longer. Stamens 4, united at base with round pollen sacs. Pistil with two 2-lobed carpels. Nutlets smooth.

Commonly propagated by cuttings made in late summer, rooted in sand that is kept moist through winter, then transplanted. Since plant is sought for its foliage rather than for its flowers, forcing techniques are not so important. Does best at a temperature of 60-75°F. where there is abundant moisture.

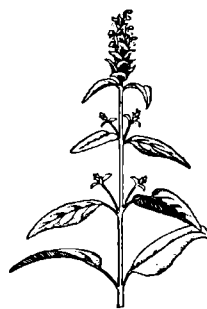
Common potted plant or border plant that does well also in window boxes if properly cared for. Best to grow new plants each year since cut-back old plants are scraggly. Requires direct sunlight for best colors. Mealy-bug enemies controlled by nicotine fumigation, or spray with fishoil-coal-tar-nicotine spray.



Catnip



Gill over the Ground
Creeping Charley



Heal All

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Labiatae

Catnip

Nepeta cataria

Height to 3 ft. Stems erect, spreading, branched, grayish-green and lighter than most mints. Leaves opposite; dark above and light beneath, to 3 in. long, with rather deeply scalloped or notched margins, sometimes clustered close to ground, rather long-petioled, not stiff, rather thick. Substantial root system.

Naturalized from Europe. Established from New Brunswick to Georgia, west through Utah to Oregon; also in Cuba. Native of Asia as well as of Europe. Some 150 species of the genus mostly native of Europe and Asia but this is probably one of the better known.

Flowers in relatively small coarse spike-like clusters at ends of branches. Clusters to 4 in. long. Flowers white to purple or pale blue, with purple markings on dots. Corolla to $\frac{1}{2}$ in. long, with main lobe a little longer than calyx. Insect-pollinated. Fruit 4 brown nutlets, with paired white spots.

Leaves and tops used in drug trade. Propagation by division or by seeds. Seeds sown in rows in late fall or spring; 4-in. plants thinned to 1 ft. apart. Shallow cultivation encourages growth. Tops harvested when in full bloom and cured quickly to preserve color, with a normal yield of 1 ton of dried tops per acre.

Free from insect and fungous pests. Price of baled leaves to about 20 cents per lb. Oil extracted and used by trappers. Tops used medicinally as a mild tonic. Fruits found as impurities of commercial seeds. Not a persistent weed pest, since cultivation controls it adequately.

Gill-over-the-ground

Nepeta hederacea

Sprawling stems. May reach length of 18 in., with short branches turning upward. Stems root freely, usually at joints. Leaves opposite, to $1\frac{1}{2}$ in. in diameter, with scalloped heart-shaped or round blades on petioles as long or longer than blades, green on both sides, with distinct veins and strong odor.

Native of America. Found through United States and southern Canada. Close relation to catnip is not superficially obvious nor is it recognized by all botanists. It does well in all sorts of waste places but particularly where there is a good supply of moisture and little sun.

Flowers borne in axils of leaves in few-flowered clusters to nearly 1 in. long, with corolla tube to 3 times as long as calyx. Corolla blue and white or with dots that are darker. Upper stamens much longer than lower pair. Apparently pollinated by bees. Fruits, oval.

Flowering time March through June. Plant sometimes becomes a pest in lawns and flower gardens where moisture and light conditions are right. On rare occasions, it may establish itself in croplands but usually such lands are not suitable for the plant.

Control effected in lawns by close mowing after raking up the tops, or by sprays of iron sulfate, sodium chlorate, or the newer weed-killer sprays. Infested fields may be cleared by plowing. Known as creeping Charlie, robin runaway, crow-victuals, tunhoof, snake-root, hedge-maids, gill-ale, and cat's foot.

Heal-all, Selfheal

Prunella vulgaris

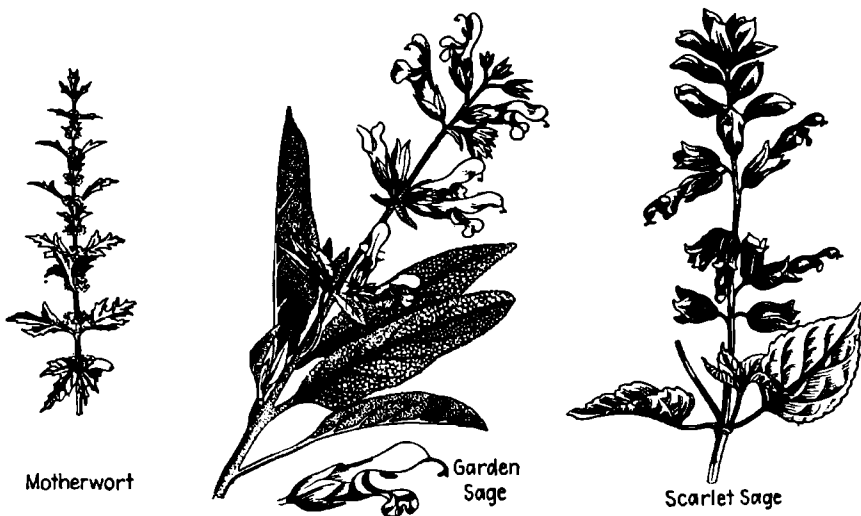
Height to 2 ft. Stems erect, ascending or sometimes sprawling; branched or unbranched; smooth or finely fuzzy; 4-angled, rather stout. Leaves opposite, to 4 in. long, petioled, with larger leaves usually above, with coarsely but shallowly toothed margins. Stems commonly root at joints. Underground rootstock.

Native of Europe but established throughout most of North America, where it was also probably native. Also native of Asia. Only 1 of 5 species of the genus that is established in North America. May become established in patches in lawns and crowd out all other vegetation.

Flowers borne in rather compact spikes at ends of branches, spikes being to 1 in. or more long and to $\frac{1}{2}$ as thick when in flower, or to 4 in. long in fruit. Flower to $\frac{1}{2}$ in. long, purple, violet, or sometimes white, with corolla about twice length of green or purplish calyx. Fruits brown, pointed.

In past, was considered to be of some medicinal value but not now. Infested lawns may have to be dug up and reseeded but in fields ordinary cultivation and plowing keep it in check. Sprays of iron sulfate or similar substances are effective as controls.

The many common names of the plant attest its conspicuous cosmopolitan nature. It is known as heart of the earth, sicklewort, bluecurds, dragon-head, brownwort, carpenter's weed, thimble flower, hookheal, and hookweed, as well as selfheal and heal-all.



PHYLUM SPERMATOPHYTES. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Labiatae

Motherwort

Leonurus cardiaca

Height to 5 ft. Stem relatively slender, usually well-branched, conspicuously 4-angled, erect or sprawling at base. Leaves opposite, long-petioled, relatively thin, 3-5-cleft with pointed segments, to 4 in. wide, dark-green even in winter when hardy rosettes persist. Strongly scented at all times.

Naturalized from Europe but native also of Asia. Widely established in waste places from Nova Scotia to North Carolina, west to Kansas and Montana or farther. 3 of the 10 Eurasian species are established in North America but this is the most typical and abundant.

Flowers in axils of leaves but usually shorter than petioles. Corolla pink, white, or purple, to $\frac{1}{2}$ in. long, with a ring of hairs within tube, with lower lip mottled, white, and woolly on outside. Stamens protrude from corolla throat. Calyx persistent, with stiff teeth. Pollination by bees. Fruit, 4-angled nutlets.

Requires water but comparatively little sun. Underground rootstock permits persistence but this may be destroyed easily by plowing or by cultivation. Green currant aphids live in summer on motherwort as an intermediate host; because of this, the plant may well be destroyed.

Once believed to have considerable medicinal value but now believed to be worthless in that respect. It is also known as lion's-ear and cowthort.

Sage

Salvia officinalis

Shrub or semishrub. Height to 1 ft. More or less white woolly. Leaves opposite, entire, long-petioled; the lower white with abundant wool beneath, to 2 in. long, roughened with rather conspicuous veins. Plant appears to be an irregular mass of ascending stems springing from a common root base.

Native of southern Europe, where, in Dalmatia, it is raised extensively. Throughout Mediterranean region it has long been under cultivation. Old in America. Does well in any rich soil. Related to such sagebrushes as *S. carnosa*, Great Basin blue sage; *S. columbariae*, China; and *S. mohavensis*, Mohave sage of the Southwest.

Flowers purplish, blue, or white, with corolla about $\frac{3}{4}$ in. long and with an interior hairy ring; arranged in whorls about stem, somewhat bell-shaped with thin but conspicuous calyx; bloom during summer months. Some varieties have yellow, red, or white leaves. Fruit 4-parted. Seeds germinate readily without acid treatment.

Plant in well-drained, fertile soil, in early spring, in rows 2 ft. apart; thin to 12 in. apart, or set as cuttings that had winter mulch cover. Collect leaves at maximum growth, dry them away from sun, but stir to prevent mold. Fair crop first year, but better succeeding years; yields to 1 ton dried tops per acre worth 5 cents per pound.

Volatile oil contains pinene, cineol, and salvol, all having warm bitter sharp taste, used in flavoring flat foods. Gum and resin also produced. Oil obtained by water distillation by alcohol extraction. Used as stimulant or tonic or in infusion; standard portion is 1 tsp. of leaves to 1 cup of boiling water per day.

Scarlet Sage

Salvia splendens

Height to 3 ft. Stems shrubby or almost so, branched, light green, smooth or with fine hairs. Leaves opposite, to $3\frac{1}{2}$ in. long, pointed, with conspicuous veins, rather well-petioled, with brilliantly colored floral leaves and bracts of the flowering portion, and with both leaf surfaces smooth.

Native of Brazil. Grown extensively even in temperate regions as an annual. Most commonly seen in North in mass planting in gardens in late summer, in window boxes, or sometimes in sun parlors. Some 500 species in the genus found in warmer parts of both hemispheres.

Flowers borne in terminal, rather open, somewhat wand-like clusters, with calyx and corolla a brilliant scarlet and corolla to $1\frac{1}{2}$ in. long, with 2-6 flowers in a whorl. Some varieties have purple, crimson, or white flowers but commonest color is scarlet. Stamens uniquely hung from the middle, thus effecting clever pollination.

Does best when grown in strong sunlight and may display full bloom from July through September. Ordinarily seeds are sown indoors in early spring so that seedlings are ready to transplant after last frost. Does not do well in soil rich in nitrogen or when season is too wet or dark. Late plants may be potted for display a few months.

One of most popular of mass ornamentals but must be protected from aphids and spiders. Flowers are illustrated in many botany texts because of unique stamens and plant is usually available for classroom study in the fall. Over 50 species and many more varieties are recognized by horticulturalists as valuable ornamentals.



Mock
Pennyroyal



Oswego Tea



Spearmint

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Labiatae

Mock Pennyroyal
Hedeoma pulegioides

Height to 18 in. Stem slender, rough, branching, ascending from sprawling bases, finely fuzzy, fragrant. Leaves opposite, thin, petioled, to $1\frac{1}{2}$ in. long and to $\frac{3}{4}$ in. wide, with upper much smaller, blunt at tip and narrower at base, rather pale green but in winter dropping off and leaving slender stems. Annual.

Native of North America. Found from Nova Scotia to Florida, west to Nebraska and the Dakotas, being found in dry fields and on exposed banks. Over a dozen species native of North America. The pennyroyal of commerce is *Mentha pulegium*, a native of Europe and Asia.

Flowers in whorls at bases of leaves; rarely as long as leaves, more or less erect but not in compact clusters. Calyx fuzzy, swollen at base, with 5 teeth, 2 of which are larger than others. Corolla purplish, to about $\frac{1}{2}$ in. long. Stamens with or without anthers but more often without. Fruits, small nutlets.

Grows well on any dry sandy or gravelly soils. Seeds sown in rows in fall and covered to not more than $\frac{1}{4}$ in. depth. Seedlings appear in early spring. Weeds should be kept out. The plants should be cut in early summer when in full bloom, dried quickly in shade, and after all large stems have been removed, should be packed. Oil is distilled by steam from plants without first drying.

Under cultivation, 1 acre may yield to 1,200 lb., worth about 11 cents per pound, or 1 acre yields to 30 lb. of oil worth \$2 per pound. Oil is used in soaps and medicines and as a supposed tea and mosquito repellent.

Oswego Tea, Bee Balm
Monarda didyma

Height to 3 ft. Stem stout, erect, branching, square in cross section, smooth or fuzzy. Leaves opposite, thin, petioled, conspicuously dark-green to blue-green, rather long-pointed at tip and blunter toward base, to 6 in. long and to 3 in. wide, with longest petiole to 1 in. long. Substantial perennial roots.

Native of North America. Found from Quebec to Georgia, west to Tennessee and Michigan growing in moist places along roadsides or streams; in North Carolina found up to 5,200-ft. elevation. About a dozen species of the genus to be found in North America including Mexico, with this best known in the East.

Flowers usually in only 1 terminal whorl to a branch or to a plant. Whorls supported by green bracts. Calyx green, smooth or fuzzy, with teeth about as long as the corolla tube. Corolla brilliant scarlet, to 2 in. long, with 2 stamens whose anthers extend beyond the upper lip although they are exceeded by the pistil.

A beautiful wild flower worthy of all protection but adjusting well to transplantation in suitable soil in gardens. Removing both corolla lips reduces bee visitation to $\frac{1}{20}$; or if lower lip alone is removed, to $\frac{1}{40}$. Flowers painted another color with watercolors are about $\frac{1}{2}$ as bee-attractive as normal flowers.

Considered a good honey plant, with honeybees apparently seeking it wherever possible. As an ornamental it is popular for its late summer or early autumn bloom. A variety with large heads of salmon pink flowers; in the Middle West this species is supplanted largely by *M. fistulosa*, the wild bergamot.

Spearmint
Mentha spicata

Height to 2 ft. Stems arise from underground stems, erect, nearly smooth, square, leafy throughout with ascending branches. Leaves without perioles or with very short ones, normally under $2\frac{1}{2}$ in. long, with saw-toothed margins, opposite, conspicuously ribbed, more or less green throughout, or lighter beneath.

Native of Europe and of Asia. Widely naturalized in North America. Particularly common in wet places about old gardens in eastern United States and in Middle West where it is often cultivated. Known in Biblical times: in Matt. 23:23 the Pharisees gave tithes in mint. About 30 species in the genus in North Temperate Zone.

Flowers in whorls on slender interrupted spikes, central spike, to 4 in. long, longer than lateral ones. Flower clusters narrower and more pointed than in peppermint. Corolla pale blue, smooth, sometimes purple. Calyx smooth, with teeth about $\frac{1}{2}$ as long as whole calyx.

Grows well in fertile moist soil from seed or cuttings. Tops harvested before leaves begin to fall or after first flowers appear. Oil extracted from whole plant is volatile; has ability to reduce gas in stomach. 1 acre may yield to 20 lb. of oil worth to \$3.50 per pound, while dry herb is worth to 45 cents per pound.

Greatest use is as flavoring, particularly in chewing gum, but also used in mint juleps, in sauces particularly for use with lamb, and in delicious jellies. Applied externally, oil may cause a flushed skin but is really harmless. It is an official drug plant, of commercial and medicinal importance in many cases.



Peppermint



Potato

Jerusalem Cherry



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales

Family Labiatae

Peppermint

Mentha piperita

Height to 3 ft. Stems erect, more or less crowded, branched, smooth, aromatic. Leaves without petioles, to 3 in. long, smooth or slightly fuzzy along veins on underside, opposite, rather dark-green, spotted with little oil globules, pointed at free ends.

Native of Europe. Widely naturalized in America where it grows in relatively thick stands in water-soaked or well-watered ground. Has been cultivated as a crop in America for more than 100 years. Related Japanese mint *M. arvensis* var. *piperascens* is cultivated in Japan as a source of menthol.

Flowers in thick spikes to 3 in. long, central one often being shortest. Corolla purple or rarely white, smooth, mint-like. Calyx tubular, 5-toothed, resin-dotted. Flowers July through September, but rarely conspicuous.

Propagation by roots and runners, set 3 in. deep continuously in rows 3 ft. apart, on any good cornland. Does well on muckland or on loam, with 12 tons per acre of well-rotted manure. May yield for a number of years 3 tons of dry material per acre worth to 30 cents per pound or 30 lb. of oil per acre worth to \$2.90 per pound.

Michigan, Indiana, and the Pacific Northwest are important centers of production, yielding around 400,000 lb. of oil a year. Oil used in candy, soap, perfume, gin, and in external and internal medicines to cure rheumatism, toothache, neuralgia, stomach troubles, and colds. An officially recognized drug.

Potato, Pomme de Terre

Solanum tuberosum

Height to 3 ft. Stem usually weak, pungent, somewhat sticky, with characteristic odor. Leaves to 10 in. long, compound, with an odd number of leaflets; larger pairs often with smaller pairs between. Underground tuber is the stem we eat, the eyes being rudimentary buds. Biennial.

Native of temperate part of Andes in South America but widely introduced throughout habitable parts of the world and serving as a staple food. Does best where there is a cool growing season, this being more important than soil. England, Germany, New Brunswick, Maine, Montana, and Idaho are important potato-producing centers.

Flowers white to bluish, somewhat star-shaped, borne in rather long drooping supports, from 1-1 $\frac{1}{4}$ in. across. Fruit, infrequently produced, a yellowish-green $\frac{3}{4}$ in. globular berry with 2-3 cells, each containing a number of seeds. "Seed" potato of commerce is a piece of the tuber, not a true seed.

Seed potatoes grown in North are commonly used in South but Northern farmers must grow their own. When cash is not available for purchase of seeds, they are grown by planting second crop and getting low-yield crop suitable for seed but not for market. Cut tubers into sections and plant pieces.

In 1846, a potato blight in Ireland caused a terrible famine. In World War II, Germans fed tops to stock and ate the tubers themselves or made them into flour or used the starch in manufacturing. The plant is attacked by serious fungous blights and by the Colorado potato beetle.

Jerusalem Cherry

Solanum pseudo-capsicum

Shrub. Height to 4 ft. Branches freely, smooth and generally erect, varying greatly with the conditions under which it is grown. Leaves narrow, to 4 in. long, narrowed at base and more blunt at free end, entire or with wavy margins, smooth on both sides but upper surface more shining than lower.

Native of Old World. Widely introduced and grown as a house plant or sometimes in suitable climates as an outdoor ornamental. It is related to the potato, like more than 1,000 other species of the same genus.

Flowers white, somewhat like those of the potato, to $\frac{1}{2}$ in. across, borne separately or in small numbers from sides of stems rather than from tips. Fruits brilliant yellow or orange and about size of a large cherry, long-persistent, making the heavy-bearing plant an attractive ornamental.

A relatively common ornamental house plant that can be grown from seeds or from slips. The attractive fruits unfortunately contain the poisonous alkaloids solanocapsine, solanine, and solanidine, and may cause a severe poisoning if eaten by human beings.

A popular house plant particularly where it is desired that the attractiveness be considerably prolonged.



Egg Plant



Tomato



Pepper

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Solanaceae

Eggplant

Solanum melongena

Height to 4 ft. Bushy gray fuzzy, sometimes spined stems, much-branched. Leaves to 15 in. long, not compound, thick and heavy, pointed at tip; with obscure lobes or angles, alternate, thick, coarse, somewhat gray hairy, or even with weak spines. Root system spreading.

Native of India but established widely as a commercial food plant. Popular varieties in the East are New York Purple and Black Beauty. Varieties have been developed to meet many needs.

Flowers borne opposite leaves, singly, nodding, to 2 in. across, violet in color and much like the better known flowers of potato or tomato. Fruit a large blue-black egg-shaped berry that may be to 1 ft. long, shining and sometimes yellow, white or striped, with pulpy interior in which are embedded many seeds.

Grows best in warm sandy well-drained loam. Seeds started in hotbeds, from 8-10 weeks before being transplanted after danger of frost is past. Plant seeds at depth of 1 in. and transplant to 2 ft. apart in rows to 2 ft. apart. Fruit matures in about 100 days after transplanting. Fruit is often commonly peeled, sliced, and fried in deep fat.

Fruit believed to be a fair source of vitamin B. Fruits picked before completely mature. Pests include a wilt and fruit rot, controlled by rotation and by treating seed with corrosive sublimate, and a flea beetle and the potato beetle, controlled by screening or by bordeaux and lead arsenate sprays.

Tomato

Lycopersicon esculentum

Length of stems and branches to 6 ft. A spreading, sprawling, or somewhat climbing annual; if perennial, the young plants are erect at least at first. Leaves strongly scented, compound, to 18 in. long, with individual leaflet to 3 in. long and with incurved margins. Roots freely from where stem touches earth.

Native of South America but now grown outdoors throughout the world where climatic conditions are suitable or grown under glass where the necessary conditions do not exist outdoors. Among more popular varieties in the East are the early red Bonny Best or the Earliana. Many varieties developed to thrive in different conditions.

Flowers in clusters of 3-7, each to nearly 1 in. across, borne on jointed stalks, deeply cleft into 5 parts, yellow, with recurving petals, nodding and with persistent calyx. Fruits red or yellow spheres or flattened spheres, to 3 in. or more through, juicy, well-supplied with seeds.

Thrive best where night temperature does not go below 60°F. Overwatering of plants under glass a common fault. Pollination effected, in greenhouse, by shaking plants once a day. Seeds, started in hotbeds in late March, produce seedlings that are set in June 4 ft. apart in rows to 4 ft. apart, yielding fruits within 90 days of resetting time.

Fruits rich in vitamin A and more so in vitamins B and C. 1 lb. of fresh tomatoes equals 103 food calories, ½ oz. of carbohydrate, and 1 oz. of protein. A plant may yield 6 lb. of fruit or 12 tons to the acre. 1 bushel weighs to 60 lb. Sold fresh, green, or canned, either whole or as juice.

Red Pepper

Capsicum frutescens

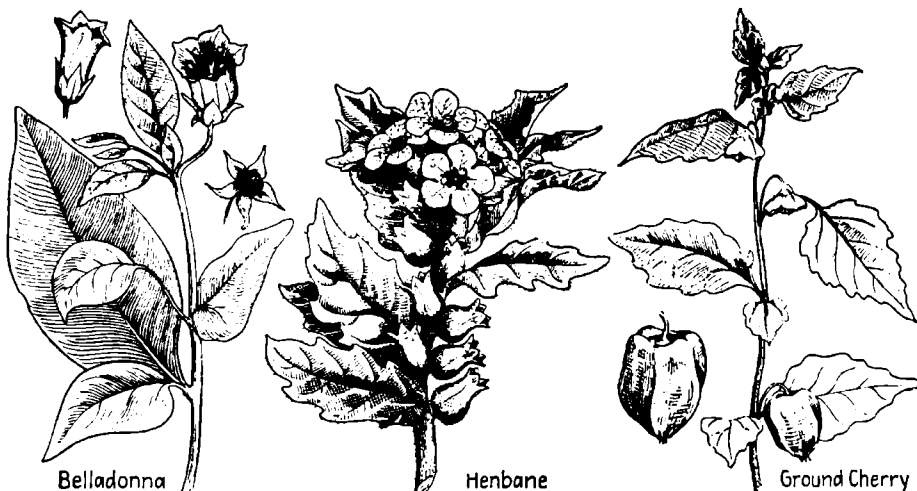
Shrub. Height to 8 ft. In North is grown as an annual. Wood hard. Trunk to 3 in. in diameter. Whole plant tender when young. Leaves to 5 in. long, usually pointed at each end but highly variable in shape, some being small and less than 1 in. long.

Native of Central and South America, with one related species from Japan. Many varieties include *fasciculatum*, red cluster pepper; *longum*, long pepper; *conoides*, cone pepper; *grossum*, sweet pepper; and *cerasiforme*, cherry pepper. Of course, the plant is best known under cultivation.

Flowers small, to ½ in. broad, usually 5-lobed, developing into the well-known thick-rinded, variable-shaped berry. Large fruits are produced by pinching off growing tips of plant. A seed packet normally contains about 200 seeds, or more than enough for a family garden.

Relatively free from insect pests in the field but in greenhouses is subject to attacks of red spiders and aphids. Persons may be "burned" by handling peppers with bare hands. Water will not relieve the burns but milk will. Paprika comes from long pointed varieties. Bell peppers mildest, used as stuffed peppers.

Food value of 13 oz. is about 100 calories. Merit lies more in stimulation of appetite for other foods than in flavor of the pepper itself. In some parts of the country, crop may yield to \$300 an acre depending on the market and the ability of the gardener to raise a superior product at the most favorable time.



Belladonna

Henbane

Ground Cherry

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Solanaceae

Belladonna
Atropa belladonna

Height to 6 ft. Erect, well-branched in upper parts, somewhat hairy. Leaves alternate, entire, on short petioles, often opposite in upper parts, to 6 in. long, dull green, pointed at tip. Root thick, fleshy, creeping horizontally, perennial, with red sap.

Native of Europe and Asia where it grows in waste places and among ruins. Has become naturalized in some places in eastern United States. 4 species of genus native of Old World. Widely cultivated in United States, Europe, and India. Red sap used in cosmetics.

Flowers in leaf axils, singly or in pairs, nodding or erect. Corolla purple or dull red, to 1 in. long. Flowers May through August. Fruit matures in September, about $\frac{1}{2}$ in. across, crowded with seeds, shining black, nearly globular, with a suggestion of being 2-lobed, with purple-violet juice.

Seeds treated 45 seconds with concentrated sulfuric acid, then washed before planting in flats. Transplanted to rows 3 ft. apart or 4,000 per acre (20,000 seeds per oz.). Requires frequent cultivation and spraying with pyrethrum or arsenate sprays to keep down cutworms. Yields hyoscyamine and hyoscyne.

Known for centuries as a poison. Drug hyoscyamine used to dilate pupils of eyes, to stimulate the heart and externally to allay pain. Used in treating whooping cough, neuralgia, scarlet fever, rheumatism, and convulsive disease, but too dangerous to be used except by physicians.

Henbane
Hyoscyamus niger

Height to $2\frac{1}{2}$ ft. Usually little over 6 in. Leaves large, to 8 in. long, oblong, commonly crowded, the lowermost with petioles clasping the stem and the upper without; midrib with long hairs, pale green. Root long, thick, spindle-shaped, brown outside and white inside, tough, fetid like tobacco.

Introduced from Europe but established in the Northern states and in Canada, particularly in the Northwest. A weed in waste places or a cultivated plant. Common about cemeteries, foundations of old houses, and other abandoned places.

Flowers funnelform, almost or wholly without stems, in a 1-sided terminal cluster, yellow or greenish-yellow with purple veins and purple throat, 5-lobed. Fruits enclosed in calyx, 2-celled, many-seeded capsules that open with a transverse lid. About 35,000 egg-shaped, brown seeds per oz. Biennial or annual.

Treat seeds 15 seconds with concentrated sulfuric acid then wash quickly to help germination. Leaves, fruits, and stem harvested when stems are not over $\frac{1}{4}$ in. through. Leaf drug collected from second-year biennials. Plant yields hyoscyamine, hyoscyne, and atropine.

Any part of plant may be poisonous to eat. Drugs from it are used like belladonna as a sedative, in treatment of convulsive diseases, in treatment of pain, to help nervous sleep, and for other purposes. Too potent to be used except on physician's advice. Known to be poisonous to poultry but in spite of popular name hog bean may not be to swine.

Ground Cherry
Physalis heterophylla

Height to 3 ft. Erect or sprawling, with erect tips. Stem rather sticky and hairy, weak and green, arising from a slender long underground rootstock, branching or unbranched. Leaves alternate, to 4 in. or more long, coarsely but shallowly and bluntly toothed at margin, with veins joined inside the leaf margin.

Native of North America. Found on rich garden soil or similar places from New Brunswick to Florida, west to Texas, Colorado, and Saskatchewan. Closely related species extend range to other continents with 30 in the United States, 2 in Europe, 6 in India and Australia, and others in South America.

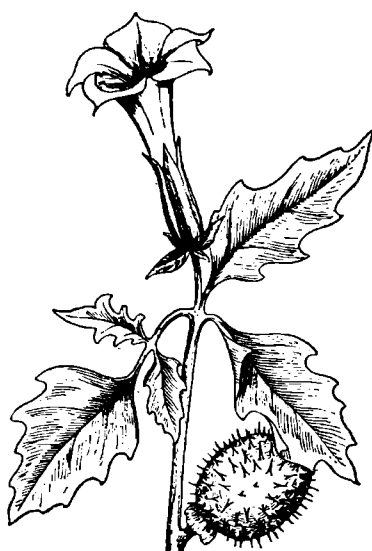
Flowers borne singly in axils of leaves, greenish-yellow with a brown or bluish center, to nearly 1 in. across, with calyx not half petal length. In fruit calyx is inflated to enclose completely and loosely the yellow, many-seeded berry.

Known as "husk tomatoes," the members of this genus are eaten raw, preserved, or cooked. Some are considered of enough importance to be cultivated for sale in markets or for home consumption. Unless ripe, they may have a strong unpleasant taste, but ripe and cooked properly, they closely resemble tomatoes.

Domestic animals have been poisoned by eating large amounts of the tops or unripe fruits. Vegetation normally so distasteful that poisoning only rarely occurs. The South American *P. peruviana*, with longer tipped, nonsticky leaves is most commonly cultivated.



Tobacco



Jimson-weed



Petunia

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales. Family Solanaceae

Tobacco

Nicotiana tabacum

Height to 8 ft. or even more. Branched or unbranched, erect stems bear enormous leaves that may be to 2 ft. long and at least half as wide, whose edges may be somewhat curled downward but whose texture varies greatly with purpose for which plant is raised. Annual. Plant may be somewhat woody at base.

Native of tropical America. Now widely cultivated over the world, being grown as far north as the northern border states in the East. Of the 50 species, some are grown only for ornament and some are trees or shrubs. One is native of Australia, others of the Pacific islands. Cultivated in Virginia by white man since 1612.

Flowers borne in loose open clusters at tips of branches, opening in full sunlight, to 2 in. long. Corolla funnel-form, woolly on outside, with somewhat swollen throat. Calyx rose-colored and much smaller than corolla. Fruit to about $\frac{3}{4}$ in. long, nearly equaling the calyx, a capsule.

Plant may yield 1 million seeds, of which 1 tsp. will sow a bed 100 ft. square in fine soil, which when transplanted will plant an acre if weeds are kept down, water is properly applied, and diseases are kept out. Transplanted about May in rows 3-4 ft. apart, topped to leave 12-20 leaves and suckers kept down.

Kentucky among most important tobacco states. Varieties include cigar, white Burley, heavy or export, and light yellow. Harvested leaves are specially dried and processed for particular purposes. About 1 billion lb. annually produced in United States for smoking and chewing; also grown as ornamental.

Jimson Weed

Datura stramonium

Height to 5 ft. Stem stout with spreading branches, purple to green, smooth or fuzzy, strongly scented. Leaves alternate, unevenly toothed, smooth, thin, green, narrowed at base, to 8 in. long, with petioles to 4 in. long, strongly scented, rather conspicuously veined. Annual.

Native of tropical regions but found established in waste places from Nova Scotia to Florida, west across the United States especially to the south. About a dozen species of the genus found over wide stretches of the world. Many races differing in color and shape of flowers and fruits.

Flowers on short stems, in axils of branches. Corolla funnel-form, to 6 in. long, with a spreading border to over 2 in. broad, white or violet or mixed or purple. Calyx about half length of corolla. Stamens, 5, separate. Fruit, spiny, to 2 in. long, egg-shaped; a capsule bearing large seeds.

All parts of plant are poisonous to cattle, horses, sheep, and human beings, even contact with leaves sometimes producing a severe dermatitis. Poison is the alkaloid hyoscyamine in the leaves, fruits, roots, and seeds, and hyoscyne in the roots. Plant is sometimes grown as an ornamental, but is dangerous.

Poison causes headache, vertigo, thirst, nausea, loss of sight and of coordination, mania, convulsions, and death. Named from Jamestown, where early settlers became crazed after eating it. Other common names include devil's trumpet, fireweed, dewberry, Peru apple, devil's-apple, mad apple, and Jamestown lily. Cultivated as a drug, yields to 1 ton of seed per acre worth to 10 cents per pound.

Garden Petunia

Petunia hybrida

Height to 3 ft. or more. Stems branched, sticky, covered with fine hairs; weak and must be supported. Leaves: broad, heart-shaped, covered with soft hairs, the upper without petioles and the lower with short ones, conspicuously veined, somewhat sticky, alternate below and opposite above.

Native of Argentina but widely cultivated for growth outdoors or in. Of the dozen or more species, all apparently come from South America. Many have established themselves as escapes from old gardens in regions where climate is suitable. Common petunia is product of crossing many kinds.

Flowers to 5 in. across, funnel-form, fringed, unfringed, or double, with color varying from white to red or purple, with stripes or bars or with special throat markings. Calyx much smaller than the corolla, with slender pointed sepals about equal to the fruit capsule.

Seeds planted in fine-powdered soil and lightly covered, thinned or transplanted so that plants are to 18 in. apart. Plants should bloom from 2-2½ months after seeds are planted in the open in suitable conditions but are susceptible to early frost so probably should be started indoors. May be propagated by cuttings.

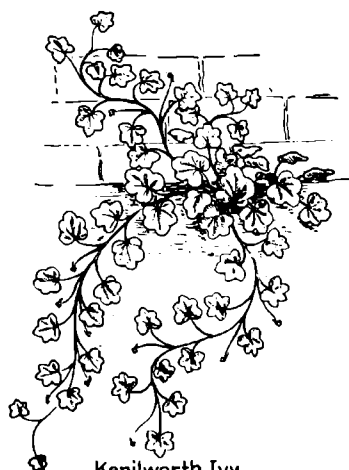
Valuable indoor and outdoor ornamental. Double forms produced by crossing the small amount of pollen produced by a double flower onto the pistil of a normal flower, with to 25% of the crosses possibly being double. Completely double flowers are propagated by slips taken in September and October. House plants need night temperature down to 45-50°F.



Mullein



Butter & Eggs



Kenilworth Ivy

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales. Family Scrophulariaceae

Mullein, Velvet Plant

Verbascum thapsus

Height to 8 ft. Stem branched or unbranched, woolly, fluted, coarse and brittle, sometimes somewhat sticky. Leaves alternate, densely woolly, light green, to 1 ft. long and half as wide, the basal ones with broadly margined petioles; the stem leaves with petioles that extend down stem as flutings. Commonly biennial.

Native of Europe and of Asia. Firmly naturalized in America and established as a weed from Nova Scotia to Florida west to California and north. Some 125 species of the genus native of the Old World, of which a few are established in America. Apparently, no native American species of the genus.

Flowers borne in long compact spikes to over 1 ft. long. Flowers yellow, crowded, to over 1 in. across, appearing from July through September. Calyx buried in the spike. Stamens unequal, with 3 upper ones short and hairy and the 2 lower longer, smooth, with larger anthers. Fruit a capsule to $\frac{1}{3}$ in. high, longer than calyx.

Pollination by self or by insects. Many small black thrips are found among the hairs in fall. Plant is a sun lover that can prosper on bare lands not suitable for competitors and is left untouched by grazers because of felt of hairs. Hairs may cause a dermatitis to some persons. Fall rosettes close to ground are common.

Seeds and plant listed by quacks as having some medicinal value but this has not been recognized. It is considered of some ornamental value. The seeds are found as a relatively common impurity of commercial seeds. Deep-penetrating root system helps it survive drought conditions well.

Butter-and-eggs

Linaria vulgaris

Height to 3 ft. but usually less. Slender erect stems are smooth, leaf-crowded, and pale green, branched or unbranched, arising from short perennial rootstocks. Leaves narrow, entire, mostly alternate, to $1\frac{1}{2}$ in. long and without distinct petioles, with a fine fuzz that may rub off easily. Perennial.

Native of Europe and of Asia but established in America from Newfoundland to Georgia, west to California and Oregon. Also found south into South America. It lives mostly on dry waste soil and may form clear stands crowding out other species. Over 100 species in the genus, mostly of north temperate regions.

Flowers borne in compact clusters at ends of branches, making a spike-like formation but for fact that flowers are short-stalked. Flowers to $1\frac{1}{4}$ in. long, with spur of the erect corolla darker. Corolla orange and white or yellow and white. Calyx short. Fruit dry capsule containing black wafer seeds.

Flowers July through October. Pollination by bumblebees and such butterflies as *Colias philodice* and *Melitoea phaeon*. Black wafer seeds are blown freely by the wind, being freed on through the winter months. Plant is beautiful enough to be an ornamental but too independent of care to be popular.

When it becomes established as a weed, the recommended procedure is to plant the area to open cultivated crops and cultivate late into the season; then follow this by a close annual crop that may smother the weed. It often becomes established near cemeteries with such plants as periwinkle and cypress spurge, other mat formers.

Kenilworth Ivy

Cymbalaria muralis

Length to about 12 ft. Stems trailing, weak, rooting freely at joints, relatively thin, smooth, branched. Leaves mostly alternate, to $1\frac{1}{2}$ in. broad, with rounded blades, distinct lobes, petioles longer than blades, smooth, purple-tinted beneath and a rich green on top.

Native of Europe. Established in wet places from Ontario to New Jersey, west through Pennsylvania but grown rather commonly as a greenhouse or sunroom ornamental in pots. Old World species in the genus but none apparently to be found native in America.

Flowers solitary, in axils of leaves, to about $\frac{1}{2}$ in. long, blue or lilac; in general, resemble a diminutive snapdragon or butter-and-eggs flower. Corolla irregularly 2-lipped, with 3 lobes in one and 2 in the other. A small calyx and 4 stamens. Fruit a capsule containing several seeds.

Propagated by seeds or by cuttings, seeds being normally planted in medium garden soil in good light and kept at a temperature close to 60–70°F. to be at best. A relatively easy plant to grow, rather free of insect and fungous pests although aphids may attack it sometimes.

Essentially useful as an ornamental either for growing indoors in sun parlors or greenhouses or outdoors in window boxes or on walls where a crawling plant is to be desired. Apparently, it has no importance as a weed, poison, or producer of medicine.



Snapdragon



Monkey Flower



Foxglove

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales. Family Scrophulariaceae

Snapdragon

Antirrhinum majus

Height to 3 ft. or more. Commonly branched or unbranched stems, downy in the upper areas but smooth below, slender, arising from a perennial root system. Leaves entire, opposite or alternate, narrow, to 3 in. long, dark-green, either pointed at both ends or essentially oblong with pointed ends, smooth, short-petioled.

Native of southern European countries but escaped from gardens and sometimes established as a weed in the East. Cultivated widely in gardens and to some extent as a greenhouse plant. Related lesser snapdragon *A. orontium* also is an escape from cultivation. About 40 species native of Europe, Asia, and North America.

Flowers to 1½ in. long, in rather open clusters at ends of branches, red, purple, white, or mixed but commonly reddish-purple in the escaped forms; sometimes borne in axils of leaves, with a small calyx and a corolla with a wide tube and a wider spread 2-lobed lip. Stamens, 4. Fruit a capsule to ½ in. long.

Normally perennial but grown as an annual in the North. Seeds planted early either in open or under glass may produce plants that flower in August. These may be potted and held over winter or covered with a deep mulch. They survive in same sort of conditions that favor geraniums and similar house plants.

Often planted in masses to make beds or as borders though for latter purpose they are higher than is usually favored. Many cultivated varieties offering low plants with almost any desired selection of color in flowers. Common names include tiger's-mouth, rabbit's-mouth, alf s-snout, toad's-mouth, dragon's-mouth, dog's-mouth, liver snap.

Monkey Flower
Mimulus ringens

Height to 3 ft. Stem branched or unbranched, 4-angled and 4-winged, erect, smooth, bright green. Leaves opposite, clasping at base, to 4 in. long and to 1 in. wide, with conspicuous veins joined inside the shallowly notched leaf margin, clean green, long-pointed at free end. Perennial.

Native of North America. Found from Nova Scotia to Virginia, west to Texas and Manitoba reaching an elevation of to 3,000 ft. in Virginia. Cultivated to some extent and a number of varieties have been developed for ornamental purposes. About 40 species in the genus native of North America.

Flowers borne in axils of uppermost leaves, on slender stems that in fruit reach to 2 in. long, or 2-4 times calyx length. Calyx nearly as long as corolla tube and with pointed tips. Corolla tubular, with irregular flaring brim, to 1 in. long, blue, white, pink, or violet. Fruit a ⅓-in. capsule.

Garden species is *M. luteus*, with yellow dark-spotted corollas to 2 in. long. Seeds of this species sown indoors in January in fine soil may yield plants that will flower by late summer. They favor cool shady wet spots and may be kept through winter if night temperature goes down to around 45°F.

Common name refers to assumed resemblance of corolla to face of a monkey, an assumption that is not always easy to justify. Many horticultural varieties of the garden species; the wild species here listed is commonly used in wet wild-flower gardens.

Foxglove
Digitalis purpurea

Height to 5 ft. Stem stout, rigid, erect, usually unbranched, slightly fuzzy, green. Leaves alternate, with relatively long petioles, and margins with rounded saw-teeth, lower being relatively long petioled, and to 10 in. long, while upper lack petioles and are smaller. Perennial or more commonly biennial.

Native of Europe but established in North America as an escape from cultivation. From southeastern Canada to New Jersey, west to California and Washington, but not extensively in many places. Cultivated in many parts of the world, including the United States. 20 species of the genus native of Europe and Asia.

Flowers in clusters along tips of branches, on short slender individual stems, more or less from one side, hanging bell-like with inflated tube and small flaring unequally lobed lip, to 2 in. long, purple to pale blue or white. Calyx usually under ¼ length of corolla. Fruit a capsule splitting to free seeds.

Hard to raise. Best in ordinary well-drained garden soils. Best to sow seeds in February, mixed in fine sand, distributed evenly over well-protected flats in greenhouses, then set 1 ft. apart in rows in fields. Blooms form second year, so plants need protective mulch first winter. Leaves contain the glucosides digitoxin, digitonin, and digitalin.

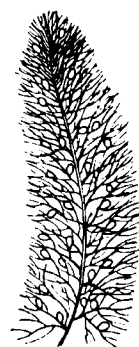
Leaves of either year valuable for medicine, 1 acre yielding to 600 lb. worth to 25 cents per pound, many leaves being collected from wild plants. Poisoning from excessive use may cause nausea, loss of appetite, dullness, increased pulse, contracted pupils, and intestinal disturbance.



Speedwell



Lousewort



Bladderwort

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales

Family Scrophulariaceae

Thyme-leaved Speedwell

Veronica serpyllifolia

Height to 10 in. Stems sprawling, slender, branching, rising at tips or erect for most part. Leaves opposite, the lower petioled and the upper without petioles, with wavy or entire margins, to $\frac{1}{2}$ in. long, oval or oblong in general shape, smooth or finely roughened. Perennial.

Native of North America and of Europe. Found from Labrador to Georgia, west to California and Alaska reaching to elevations of 2,600 ft. in the Catskill regions of New York. Some 200 species of the genus found throughout world with better than a dozen native of North America.

Flowers in loose open clusters at ends of branches, with each flower borne on a separate little stem as long as or longer than the calyx, which is in turn nearly as long as the corolla. Corolla blue with darker stripes, or white, to $\frac{1}{3}$ in. across. Fruit broader than high. Seeds, flat.

Flowering time April through September. Sometimes a weed in lawns, pastures, or other places where cultivation is not common, but it yields quickly to competition or to cultivation. Hoeing, crop rotation, and sprays of ammonium sulfate, sodium chlorate, or other weed killers are effective.

2 of the related species, *V. officinalis*, *V. chamaedrys*, have found use as a substitute for tea. Another, *V. americana*, has been recommended as a dietary preventative for scurvy and some species have been used as potherbs; all are high in vitamin C.

Lousewort, Wood Betony

Pedicularis canadensis

Height to $1\frac{1}{2}$ ft. Stems in tufts, smooth, or smooth above and fuzzy below, usually unbranched, leafy. Leaves alternate, many of them arising from crown of underground portion, to 5 in. long, mostly slender-petioled, with margins notched halfway to midrib.

Native of North America. Found in woods and relatively dry thickets, often on poor soil, from Nova Scotia to Florida, west to northern Mexico, Colorado, and Manitoba, with related species extending range. About 30 species in the genus in North America; about 125 in the world all in Northern Hemisphere.

Flowers in crowded rather dense spikes at tips of stems, with the spike lengthening to 8 in. sometimes when in fruit. Corolla to nearly 1 in. long, with overhanging upper lip longer than 3-lobed lower lip and tube much longer than calyx. Fruit about $\frac{3}{8}$ in. long.

Flowering time April through June, when the plant is visited by such pollinating insects as bumblebees and honeybees. Some members of genus are used commonly as ornamentals in rock gardens and in wild-flower gardens but some may be parasitic on certain other species of plants.

Plant is named *pedicularis* because it was formerly reputed to cause sheep that fed on it to become infested with lice. It is rather doubtful whether this association is justified.

Family Lentibulariaceae

Greater Bladderwort

Utricularia vulgaris

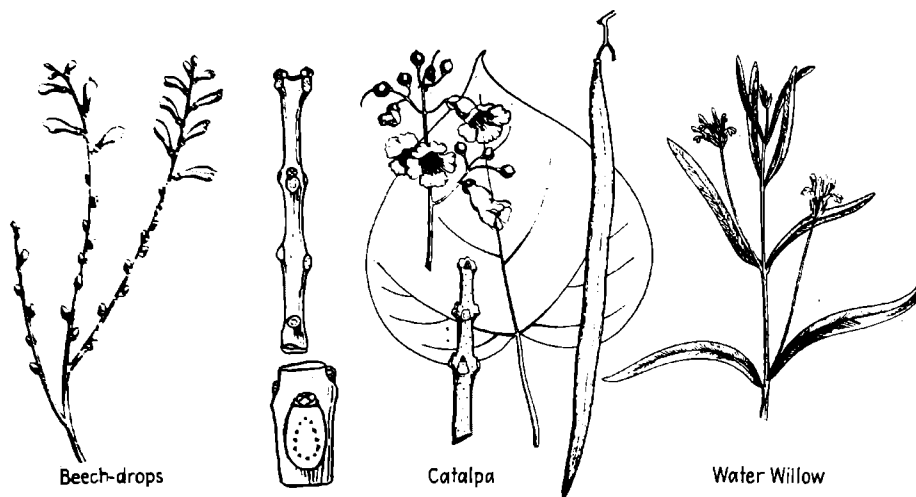
Stems to 3 ft. long, somewhat branched without roots, floating horizontal under the surface of fresh but stagna water. Leaves alternate, to 2 in. long with sections repeatedly forked in 2's or 3's and bearing near base bladders that are to $\frac{1}{10}$ in. long.

Native in one variety or another from Eurasia through North America, the variety being found from Newfoundland to Maryland, west to Low California and the Yukon. American variety has longer stems than does the European. About 75 species of the genus, of world-wide distribution.

Flowers borne on erect stems that rise above surface of water, the individual flower stalks being to nearly 1 in. long and the whole cluster to possibly 2 ft. high. Corolla yellow, to nearly 1 in. long with the lower lip longer and broader than the upper. Fruit, capsule.

Bladders are unique structures that capture minute water animals and apparently digest them. Such animals as water fleas are known to be captured when they thrust their antennae into the bladder opening, after which they are held until the animals die. Physiological story back of this is not definitely known.

Plants are eaten by a number of the larger animals that feed in marshes, such as moose and deer, and by some aquatic birds. Winter is survived by the production of winter buds that start new plants the next year, or by the production of seeds.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Polemoniales

Family Orobanchaceae

Beechdrops

Epifagus virginiana

Stem to 2 ft. high, branched or unbranched, with a scaly base and few scales along the erect stem arising from the fibrous and brittle root that contacts the beech tree host's root system. Foliage tough, brown-stained, almost woody, medium slender, and looking more or less dead.

Native of North America. Found from Nova Scotia to Florida, west to Louisiana and Michigan or Wisconsin, about same range as that of host plant the beech. Only 1 species in the genus though there are 4 few-seeded genera in family in eastern North America. About 200 species in whole family.

Flowers more or less tubular, to nearly $\frac{1}{2}$ in. long and about $\frac{3}{10}$ in. thick, with the calyx under $\frac{1}{4}$ the length of the relatively closed-mouthed striped purple and white corolla. Stamens about length of corolla although style of pistil is a little longer. Fruit a capsule to $\frac{1}{4}$ in. long. Lower flowers to $\frac{1}{10}$ in. long.

Flowering time August through October, when flowers are visited by bees but cross-pollinate the upper flowers. Lower flowers are self-pollinated (cleistogamous) and lack purple and white markings of upper insect-pollinated units. As suggested above, plants are parasitic on roots of beech.

If little damage to the host plants and probably of no great economic importance. The plant is listed by quack doctors as having some medicinal properties but this is doubtful.

Family Bignoniaceae

Catalpa, Indian Bean

Catalpa bignonioides

Tree. Height to 65 ft., with trunk diameter to 4 ft. Trunk short, breaking into relatively few coarse branches that make a symmetrical crown. Leaves opposite or whorled, to 6 in. or more long and nearly as wide, heart-shaped at base, pointed at free end, on petioles to 6 in. long, pale downy, with an unpleasant odor when broken.

Native of the Gulf States. Now extensively cultivated into Northeast as far as central New England and west to Rocky Mountains. Also found in Europe. A number of ornamental varieties. Closely related *C. speciosa* has flowers with purple on the interior, not spotted as are the interiors of this species.

Flowers in huge open erect terminal clusters, with individual flowers white, mottled with yellow and purple inside, or lined with purple, to 2 in. long, very showy with inner part of tube with yellow blotches and parallel purple ridges. Stamens, 2, slightly longer than corolla tube. Fruit to $1\frac{1}{2}$ ft. long and to $\frac{3}{4}$ in. thick.

Wood light, weak, soft, coarse-grained, durable in contact with soil, gray-brown with a bluish tinge and thin whitish sapwood. Tree is a quick grower but winterkills freely in the northern part of its range. Flowering time is from June through July with the fruits persisting through winter, breaking and shedding wafer-like seeds.

Used as an ornamental or as a wind-break where other trees often will not survive. Wood used as fence posts, poles, and railroad ties largely because of durability in contact with the soil. Foliage and flowers are definitely attractive, but in winter the tree looks bedraggled.

Family Acanthaceae

Water Willow

Dianthera americana

Height to 6 ft., though a portion of this may be sprawling. Stem branched or unbranched, woody, smooth, slender. Leaves opposite, entire, to 6 in. long and to $\frac{3}{4}$ in. wide, narrowed near base to form short petiole in lower leaves and with drawn-out tip.

Native of North America. Found growing in wet places or in edge of waterways from Quebec to Georgia, west to Texas and Ontario, with closely related species extending range westward and southward. Some 100 species of the genus, mostly native of tropical America, Asia, and Africa.

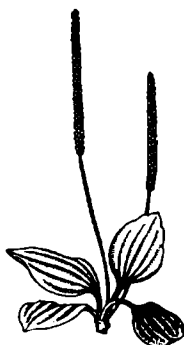
Flowers borne in relatively few-flowered heads, at ends of slender stems arising from axils of leaves, with white or violet corollas to $\frac{1}{2}$ in. long, with tube longer than lips and base of lower lip definitely roughened. Fruit a capsule to $\frac{1}{2}$ in. long, compressed, longer than calyx.

Flowering time May through September. Ecologists recognize a service performed by the plant in anchoring soft soil shore lines from erosion by waves or by stream currents. Trash accumulating among the stems helps build soil.

In some places, planting of this species has been recommended for fixing shore lines that might otherwise be destroyed or shifted. Apparently the plant is eaten occasionally by browsing animals that feed at the water's edge.



Lopseed



Common Plantain



Narrow-leaved Plantain

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Polemoniales
Family Phrymaceae

Order Plantaginales
Family Plantaginaceae

Lopseed

Phryma leptostachya

Height to 3 ft. Herbaceous. Stem erect, 4-angled, slender, branched, with swollen joints, dark-green. Leaves opposite, to 6 in. or more long, thin, green, the lower on long petioles and the upper sometimes without them; margins of blade with shallow rounded teeth; veins joined inside margins.

Native of North America. Found in woodlands and brushy spots from New Brunswick to Florida, west to Kansas and Manitoba; also in Bermuda and eastern Asia. Apparently, in spite of wide distribution, only 1 species in genus and 1 genus in family, an almost unique situation.

Flowers borne along sides of erect tips of branches, rather well-separated from each other and from the leafy portion, mostly opposite, about $\frac{1}{4}$ in. long, extending out from stems at right angles when in flower but depressed to the stem when in fruit, with the calyx surrounding the fruit.

Flowering time June through September. Fruit at best in late summer and fall after it has become mature, when it breaks free from the stalk violently when touched. In this way, it may be thrown for some distance. Calyx may serve in a weak way to attach freed fruit to wool of animals.

Not of any apparent economic importance, nor is it considered of a medicinal or poisonous nature. An interesting plant to investigate when the fruits are mature, merely to see how far the fruits may be hurled when freed.

Common Plantain

Plantago major

Stemless. Leaves arise in rosettes from head of fibrous and many-branched root system, with 5-7 lengthwise veins and with conspicuously long-channeled petioles to 10 in. long, with entire or coarsely toothed margins, firm, usually flat on the ground unless there are competitive plants. Perennial.

Native of Europe. Also apparently of America where it is now found through most of North American continent and in West Indies. Also found in Asia. Grows in almost any place where man maintains lawn grass.

Flowers borne along an erect flowering stem, crowded to make a long "rattail" spike that may be to 18 in. long. Pistils mature before the stamens so flowers of one part of spike may, with the help of wind, gravity, or insects, pollinate other flowers of the same spike. Fruit a capsule containing to 18 sticky seeds.

Flowers May through September. Fruits June through December. Serves as food for larvae of a beetle; 5 flies use leaves as mines. Seeds eaten by insect larvae and by birds. Plant 81% water, 11% nitrogen, 2% fiber, and 3% protein and fat. Sticky seeds help in distribution. Plant cannot survive competition.

Used in China as a potherb and often used in America as spring greens, or dried leaves used as a tea-substitute. May be controlled by cutting, by salting, by digging, or by the better weed sprays. Does not survive cultivation nor does it do well in very rich soils.

Narrow-leaved Plantain

Plantago lanceolata

Stem above ground short or apparently absent, with leaves rising directly from root system which is a short rootstock, with contributing fibrous roots. Leaves narrow, with entire margins and usually 5 more or less conspicuous parallel ribs, to 1 ft. long and to 1 in. wide, usually more or less pointed at each end.

Common on lawns and in waste places of wide areas in the world. Native of Europe and of Asia. Found in America from New Brunswick to Florida, west to California and British Columbia though in the west it is replaced in abundance by closely related species. Some 200 species in the genus, some being serious weeds.

Flowers borne in short, dense spikes at end of leafless flowering stems that rise to a height of over 1 ft. Pistils mature first at upper end of spike, with the long-filamented stamens following and waving yellow anthers freely. Pollination mostly by wind but sometimes by insects. Flower produces a 1-fruited, 2-seeded capsule.

Serves as host for larvae of some tiger moths and the buckeye butterfly. In summer an apple pest, *Aphis sorbi*, lives on this too common weed. Survives drought or flood and since seeds retain vitality in soil many years may become a persistent pest even where care is observed. Tops should not be allowed to seed.

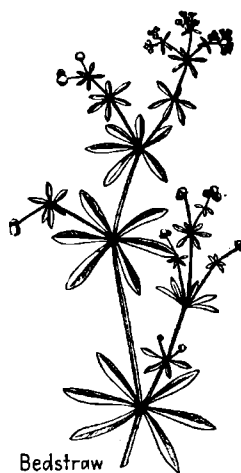
Cultivation, hoeing, and the better weed sprays may be effective in keeping it under control. Formerly believed to have medicinal value but not now so used. Tops provide food for seed-eating birds including pheasants and quail. Perennial. Known as rib grass, ripple grass, blackjack, jackstraw, English plantain, buckhorn, and rattailed plantain.



Bracted Plantain



Woodruff



Bedstraw

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Plantaginales Family Plantaginaceae

Bracted Plantain *Plantago aristata*

Stemless except for flower-bearing stem that reaches a height of 1½ ft. Leaves slender, much like those of narrow-leaved plantain, to 1½ ft. long, and to ½ in. wide, often conspicuously 3-ribbed, entire, narrowed into fine petioles, smooth or downy, dark-green. Annual.

Native of North America. Found in dry meadows, grasslands, waste places, and sometimes in lawns from Maine to Georgia, west to New Mexico and British Columbia, being more common in Middle West than in East. Related to other species extending the range. Over 200 species in the genus.

Flowers borne in spikes at tops of erect flower stalks and interspersed with bracts, which may be nearly as long as the 6-in., terminal cylindrical spike or 10 times the length of small inconspicuous flowers. Fruits, capsules bearing 2 seeds, with convex and concave surfaces.

Flowers May through October. While it may become a weed in some localities, it may usually be controlled by using a green manure crop that may be plowed under, and following this with clean-cultivated crops for at least two seasons until most seeds have been destroyed. Plants should not be allowed to seed.

A conspicuous weed in waste places in the Middle West but not so resistant to control as are the narrow-leaved and the common plantains. Has such common names as clover choker, western buckhorn, western ripple grass, and large-bracted plantain.

Woodruff *Asperula odorata*

Height to 8 in. Stems square, erect or ascending, arising from a slender creeping rootstock. Leaves usually in whorls of 8, with finely toothed or roughened margins, pointed at each end, fragrant when dried, smelling much like hay to 1½ in. long. Some species smooth, some rough. This species is perennial.

Native of Europe and the Orient but grown as an ornamental through most of the temperate regions of the world. Do best in moist soil and in shade. About 80 species in the genus, of which some have been classified as weeds.

Flowers borne in terminal clusters of several flowers each, white or pink, to ½ in. long, funnelform but with a widely spreading limb, 4-lobed. Stamens, 4, inserted on the corolla. Fruit, 2-celled, bristly, with short bristles, about ¼ in. across, rough, borne on short individual stems.

Flowering time May and June. Propagation by division of plants or by means of seeds. Where they are grown in dry sunny places, they become stunted and die back during the summer while in moist, shady places they may thrive into the fall months. Plants are grown in gardens as carpets and as borders.

Known by the Germans as Waldmeister, and used by them in May wine, or *Maitrank*, or in their summer drinks. Since the fragrance of the vegetation is long-lasting, it is commonly sprinkled on stored cloth material to give it a pleasing fragrance. Also used rather commonly in home medicines though it seems doubtful if it is really valuable.

Order Rubiales Family Rubiaceae

Bedstraw *Galium aparine*

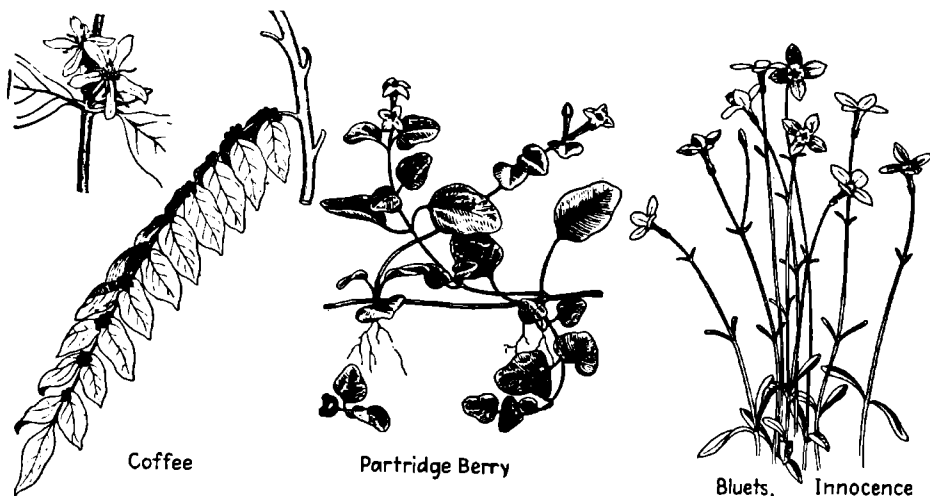
Length to 5 ft. Stems weak, sprawling over the ground, bushes or walls, with fine backward-bending but weak short stiff hairs borne on angles of stem. Leaves in whorls, with 6-8 at a joint, slender, pointed at each end and thickest near tip, to 3 in. long and to ½ in. wide, with roughened margins and midribs. Annual.

Native of Europe and possibly also of America. Found from New Brunswick to Florida, west to Texas and the Dakotas. May occur as a weed over wide stretches of territory. Over 250 species in the genus found in various parts of the world.

Flowers in clusters of 1-3, in axils of upper leaves, on flowering stems to 1 in. long, small and relatively inconspicuous, with a 4-lobed corolla and 4 stamens. Fruit to ¼ in. across, covered with short hooked bristles nearly as long as thickness of each half of the fruit, grayish-brown, warty in appearance.

Flowering time May through September. Commonest near woodlands but not necessarily in them, thriving on almost any rich sandy or alluvial soil or on bare spots in fields and meadows. Fruits apparently distributed by adhering to passing animals. Some species are considered of ornamental value.

Reputed to have certain mystic medicinal values that are not now recognized. Known by at least 60 common names among them being cleavers, goose grass, gripgrass, loveman, scratchweed, poor robin, burhead, beggar lice, hedgebur, gosling grass, pigtails, and sweethearts.



Coffee

Partridge Berry

Bluets, Innocence

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rubiales. Family Rubiaceae

Coffee

Coffea arabica

Height to 15 ft. A small tree or shrub with a main trunk that soon branches freely close to ground, the branches being horizontal, opposite or in whorls of 3. Leaves evergreen, dark glossy green, to 6 in. long and to 2 in. wide with a $\frac{1}{2}$ -in. point, opposite, thin, elliptic. Perennial.

Native of tropical Africa whence it was introduced into Arabia some 500 years ago. Reached Ceylon and Java about 1700, West Indies about 1720, and Brazil in 1770. From Arabia, it reached Venice in 1615, Paris in 1645, and London in 1650. Libyan coffee is *C. liberica* and Congo coffee *C. robusta*.

Flowers star-like, fragrant, with a delicate odor, pure white, with corolla units to $\frac{3}{4}$ in. long, this being longer than corolla tube. Fruit a deep red, 2-seeded berry about $\frac{1}{2}$ in. long. Seeds planted in beds and seedlings are set at 6-ft. intervals. Plants begin to bear in third year, give best yield in fifth year, bear about 30 years.

Young plants are grown in shade. Picked berries are dried in sun or run through pulping machine and dried by artificial heat. Parchment is removed by polishing machines and seeds are bagged. Roasted coffee contains 0.75–1.5% caffeine, the volatile aroma-producing oil caffeol, and glucose, dextrin, proteins, and a fatty oil.

United States is greatest coffee-consuming nation. Production is limited by climate, Arabian coffee needing 50 in. annual rainfall and preferring to 120 in. in areas between 25°N.L. and 25°S.L. Can be grown from sea level to altitudes of 6,000 ft. Brazil apparently leads world in production of this important crop.

Partridge Berry

Mitchella repens

Length to 1 ft. Stems semiwoody, trailing close to ground, branching freely, smooth or with a slight down, rooting freely at joints, slender, tough. Leaves opposite, short-petioled, with round to heart-shaped blades to nearly 1 in. long but usually much smaller, dark-green, shining, evergreen, conspicuously light-veined.

Native of North America. Found in cool woodlands from Nova Scotia to Florida, west to Texas and Minnesota, reaching an elevation of to 5,000 ft. in Virginia. 2 species in the genus of which this is the only one in America; other is Japanese.

Flowers borne in pairs at ends of branches, with corolla white, to $\frac{1}{2}$ in. long, tubular, with a flaring mouth divided evenly into 4 segments somewhat shorter than tube. Calyx much shorter than corolla. Stamens, 4, grown to corolla. Pistil, longer than corolla tube. Fruit a red berry to $\frac{1}{8}$ in. through.

Flowering time April through June, with sometimes a late fall flowering period. Fruits persist through winter unless they are eaten by wildlife or by human beings. In spite of frequency with which fruits of this plant are mentioned as being of medicinal value in quack literature, it apparently has no such value.

Excellent ornamental for growing in terrariums indoors. Fruits are edible but lack flavor of wintergreen and are too few and too small to be of any considerable importance. Scientific name *Mitchella* refers to early Virginia botanist John Mitchell, who was a frequent correspondent of Linnaeus.

Innocence, Bluets

Houstonia coerulea

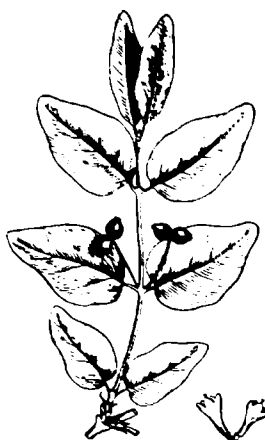
Height to 7 in. Stems erect, arising in tufts from slender perennial creeping rootstocks, usually unbranched except sometimes near top. Leaves crowded at base or paired up stem, about $\frac{1}{2}$ in. long, pointed at each end or with a short obscure petiole, often slightly downy or hairy.

Native of North America. Found in meadows, where soil is poor, or on wet exposed rocks from Nova Scotia to Georgia, west to Missouri and Michigan. Over 2 dozen species native of North America including Mexico, of which this is possibly the best known.

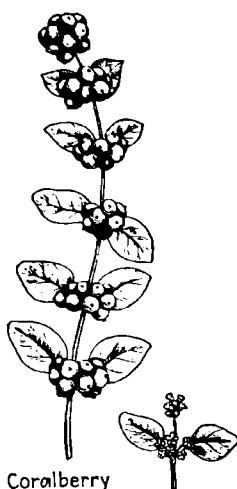
Flowers borne in pairs at ends of branches, erect, with a small calyx much shorter than tube of corolla that spreads into a flat 4-parted top. Corolla beautiful pale blue and white or violet with yellow center. Tube about length of split lobes. Fruit a capsule about $\frac{1}{10}$ in. long and slightly broader than long.

Flowering time from April through July, though flowers may be produced throughout summer under proper weather conditions. Pollination by bees and smaller butterflies such as clouded sulfur and painted lady. Used generously in rock gardens and for borders in flower gardens. Does well in some shade.

This is the "innocence" mentioned in the well-known poem "Jack in the Pulpit" by Clara Smith. It also is known as eyebright, quaker-ladies, brighteyes, Venus's-pride, little washerwoman and star-of-Bethlehem, all names indicating its popularity largely because of its beauty.



Fly Honeysuckle



Coralberry



Twin-flower

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rubiales. Family Caprifoliaceae

American Fly Honeysuckle
Lonicera canadensis

Height to 5 ft. Shrub. With smooth, light-colored twigs that branch rather freely. Leaves opposite, bright green on both sides and attractive, thin, to 4 in. long and to half that width, with short petioles, rounded at base and pointed at tip, downy when young but smooth when mature, with hairy margins.

Native of North America. Found in woodlands where there is water. From Nova Scotia to Maryland, west to Indiana, Minnesota, and Saskatchewan. Cultivated as an ornamental and grown outside natural range. Over 150 species in the genus, native mostly of north temperate areas. About 25 in the United States.

Flowers borne in pairs from axils of leaves, the flowers being borne on a single flowering stalk that is about as long as greenish-yellow, $\frac{3}{4}$ -in.-long corolla. Bracts at bases of flowers small. Open lobes of corolla short. Fruit, reddish, oval berries about $\frac{1}{4}$ in. in diameter.

Flowering time April through May. Fruits available for collecting from June through September. Plants require moisture and shade to succeed. Propagation by seeds, by division, or by cuttings. Most species are not favored food of cattle, but white-tailed deer are known to feed on this one.

This species is grown somewhat as an ornamental in proper places but other species are more suitable for growing in sun and where soil is drier. Known sometimes as "medaddy-bush." Other popular species include *L. droica*, smooth honeysuckle; *L. japonica*, Japanese honeysuckle; and *L. tatarica*, Tartarian bush-honeysuckle.

Coralberry
Symphoricarpos orbiculatus

Height to 7 ft. Branches slender, dark, upright or drooping and wand-like, downy, densely covered with leaves, purplish. Leaves opposite, to $1\frac{1}{2}$ in. long, oval, short-petioled, blunt or acute, not evergreen, smooth or downy beneath, shed late in autumn.

Native of North America. Found from New York to Georgia, west to Texas and South Dakota, being usually found on exposed rocky banks or along streams. 10 species native of North America including Mexico.

Flowers borne in many-flowered short dense clusters at axils of leaves which in fruit and flower are shorter than the leaves. Corolla bell-shaped, pink, downy inside, to $\frac{1}{8}$ in. long, with stamens included in the bell and the lobes relatively shallow. Fruit a purplish-red berry, round, to $\frac{1}{8}$ in. through.

Flowering time June through July. Fruits available September through to June. About 407,000 seeds per lb. Propagated by seed or by hard or soft-wood cuttings made below the joints and stimulated by potassium permanganate. Leaves contain saponin but in small amounts, and poisoning of stock is rare.

Commonly grown as an easily propagated ornamental that spreads once it is established. Provides excellent cover for small wildlife. Fruits are eaten by grouse, pheasant, quail, and deer. Provides an important browse in Utah, Nevada, and southern Idaho. Also important as a soil anchor by streams or on steep banks.

Twinflower
Linnaea borealis

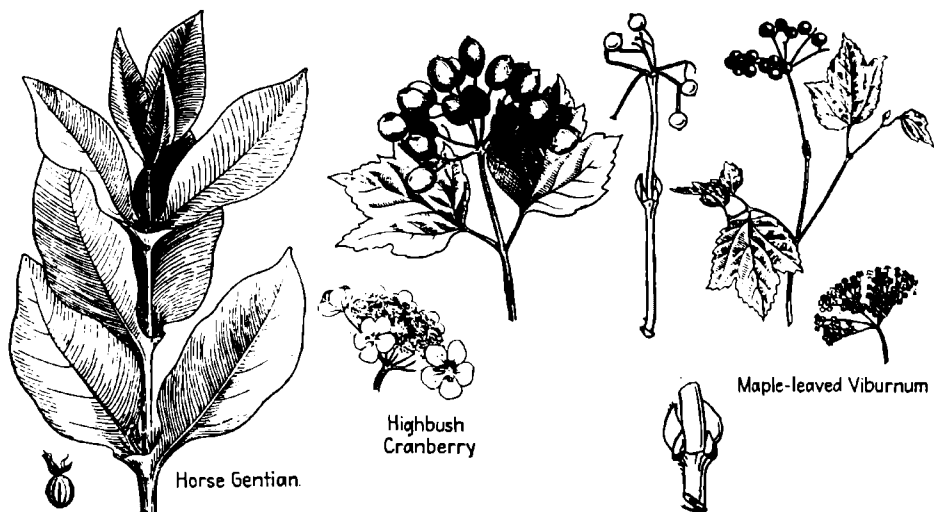
Stems trailing, to length of 2 ft., slender, branched, downy, rather rough, close to ground or under forest duff. Leaves opposite, to $\frac{3}{8}$ in. long and about the same width, sometimes wider than long, on short petioles, evergreen, borne on short erect spurs arising from the trailing prostrate main stem.

Native of North America, Asia, and Europe. Found in cold, wet, or dry woods from Newfoundland to New Jersey, west to Colorado, Vancouver, and Alaska. American form is considered a variety of *L. borealis* by some authorities. 3-4 species in the genus to be found in north temperate regions of the world.

Flowers borne in pairs at top of slender erect thread-like stems to nearly 1 in. long. Corolla bell-shaped, nodding, to $\frac{1}{2}$ in. long, fragrant, whitish, flesh-colored, or tinged with rose-purple and hairy inside. Calyx small. Fruit supported by a pair of scales that may be grown to ovary.

Flowers appear June through August. Plants do well in dry well-drained soil, in sun or in shade or where it is moist. Plant often forms a good ground cover in areas not occupied by other plants. It occasionally flowers in late autumn and sometimes there are 4 rather than 2 flowers in group.

Named after Linnaeus, the taxonomist who is usually portrayed with a sprig of twinflower in his buttonhole. It is a delight to the sight and to the nose of man but may be poisonous to cattle although it is eaten by grouse and deer.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rubiales. Family Caprifoliaceae

Horse Gentian, Wild Coffee
Triosteum perfoliatum

Height to 4 ft. Stem erect, not woody, stout, finely downy, greenish. Leaves opposite, joined at bases around stem, entire, soft-downy beneath, slightly hairy above, to 9 in. long and to 4 in. wide, rather thick but flexible, dark-green, widest at about middle and pointed at free end.

Native of North America. Found in rich soils on hillsides or in lowlands. From Massachusetts to Alabama, west to Kansas and Nebraska. Of the 6 known species of the genus, 1 is native of the Himalayan region; 2 of Japan, and 3 of North America, of which this is possibly the most widely distributed.

Flowers borne in axils of leaves, usually with 1 to each leaf in upper regions. Corolla green in lower portions and brownish-purple above, to nearly 1 in. long and rather conspicuously sticky. Calyx about length of corolla, but of slender sections. Fruit an orange to yellow berry, downy, with 3 nutlets.

Flowering time April through May. Fruiting time August through September. The pioneer American botanist Muhlenberg is reported to have dried and roasted the berries and claimed they made an excellent coffee substitute, hence the name wild coffee. Plant does not seem to have wide use in this way.

Reported by many quacks to have medicinal value but this is not considered a valid claim. That it has been widely recognized is shown by many common names such as feverfew, wild ginseng, horse ginseng, tinker's weed, white gentian, wild ipecac, and wood ipecac.

Cranberry Tree
Viburnum opulus americanum

Height to 12 ft. Stem branched, erect, smooth, relatively coarse and weak. Leaves opposite, broader than long, rather obviously 3-lobed, with coarse saw-toothed edges, 3-ribbed, rounded at base, to 3 in. or more long, with petioles to 1 in. long and bearing glands at the top.

Native of North America, Asia, and Europe. Found on low wet lands from Newfoundland to New Jersey, west to Oregon and British Columbia. Chosen as a representative of the subgenus *Opulus*, which includes the squashberry *V. pauciflorum*, with scaly winter buds. Some 100 species in the genus; some 20 in North America.

Flowers borne in open clusters at ends of branches, clusters being to 4 in. in diameter; outer flowers being more conspicuous and to 1 in. in diameter, having greatly enlarged corollas but being without either stamens or pistils. Inner flowers produce red, sour, ½-in. translucent fruit.

Flowering time from June through July. Fruiting time September through October, though they may persist until May. 16,000 seeds per lb. used in propagation, or cuttings are made. Fruits of American variety are made into delicious, beautiful jelly preferred to the bitter jelly of the European way-faring tree.

Known in cultivation as snowball tree, white dogwood, dog rowan, whitten wood, gaiter tree, cherrywood, red elder, witch hopple, pincushion tree, squawbush, May-rose, cramp bark and by other names. Fruits eaten by grouse and pheasants but leaves and twigs do not figure as important browse.

Maple-leaved Viburnum
Viburnum acerifolium

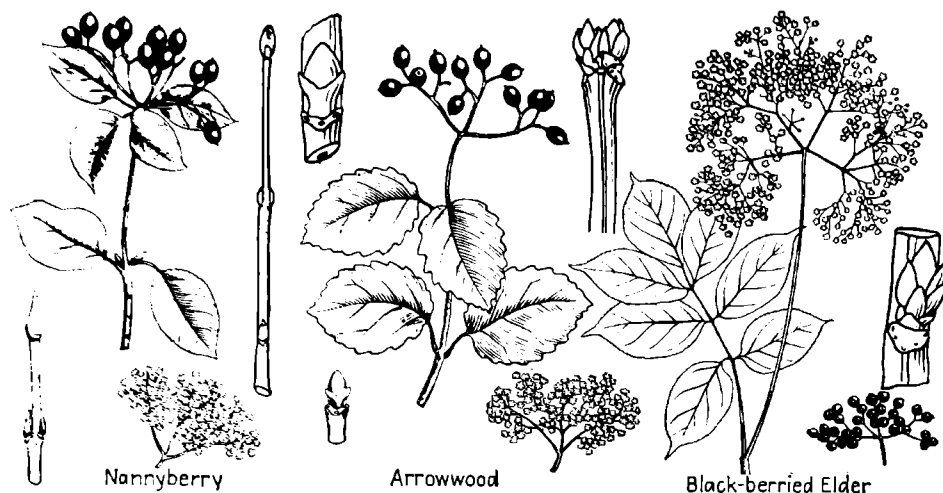
Height to 6 ft. or rarely more. Shrub. Bark gray, smooth, with slightly downy, slender straight twigs. Leaves opposite, somewhat in shape of typical maple leaf, being rather 3-lobed, with heart-shaped base and saw-toothed margins, downy when young but smooth when mature; to 5 in. broad.

Native of North America and found in dry woods or where soil is thin from New Brunswick to Georgia, west to Alabama, Michigan, Minnesota, and Ontario. Chosen here as a representative of subgenus *Euriburnum*, which in East is represented by at least 5 species including *V. dentatum* and *V. pubescens*.

Flowers borne in open clusters to 3 in. across. All flowers bear both stamens and pistils and are essentially alike, with stamens much longer than tube of corolla, which flares widely above relatively shallow tube. Fruit a stone fruit that is at first crimson but turns to black. Stone with 2 ridges on each side.

Flowering time May through June. Fruits borne normally in September and October but may persist until following July. About 4,500 fresh berries per lb. Plant a slow grower but endures smoke of cities well. It may form thickets and when cut or burned back may form straight shoots useful as arrow shafts.

Indians used wood for arrow shafts. Fruits are not fleshy enough to be of food value to man. Ruffed grouse, white-tailed deer, and cottontail rabbits are known to use the plant as food and it undoubtedly provides ideal cover for many species of small wildlife.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Rubiales. Family Caprifoliaceae

Nannyberry

Viburnum lentago

Height to 30 ft. but usually lower. Small tree or shrub. Trunk diameter to 10 in. Twigs relatively slender and winter buds smooth, slender, and pointed. Leaves opposite, to 4 in. long, smooth on both sides, with finely saw-toothed margins, with slender wavy-margined petioles to 1 in. long.

Native of North America and found in rich-soiled areas from Quebec and Hudson Bay area, south to Georgia and west to Kansas, Colorado, and Manitoba. Species given here as representative of subgenus *Tinus* which includes black haw *V. prunifolium*, wild raisin *V. cassinoides*, and a few others.

Flowers in many-flowered clusters that may be over 5 in. broad, the individual flowers being small with 5-lobed corollas and stamens that protrude much beyond the corolla itself. Whole cluster looks much like that of an elderberry. Fruit, blue-black, sweet and edible, to $\frac{1}{2}$ in. long with circular fat stone.

Flowering time from May through June. Fruit persists from August through September or later. 3,000–5,000 berries per lb. and 4,300 seeds per lb. Commonly propagated by seeds, by suckers, or by cuttings. Wood weighs about 45 lb. per cu. ft. and is orange-brown and hard. Plant withstands city smoke.

A good ornamental. Pulp of fresh ripe fruit is delicious though stone is distasteful. Usually some tart fruit is added to make the best jelly. Fruit eaten by ruffed grouse, pheasant, raccoon, skunk, fox, gray squirrel, cottontail rabbit, and, to some extent, by sheep and goats, as well as by man.

Arrowwood

Viburnum dentatum

Height to 15 ft. but usually much less. Shrub with smooth gray bark and twigs with sometimes remarkably straight shoots. Leaves opposite, oval, but with margins evenly saw-toothed, with conspicuous veins, to 3 in. broad and somewhat longer, with petioles to 1 in. long, smooth or downy.

Native of North America. Found in moist woods and thickets from New Brunswick to Georgia, west to Minnesota and Ontario. Closely related to maple-leaved viburnum but lacks the 3-ribbed maple-shaped leaf. This plant survives in moist or dry soil in the shade or in the sun.

Flowers in clusters to 3 in. across, all bearing stamens and pistils, capable of producing fruits, cluster being more round-topped than with some other common viburnums. Stamens protrude beyond tube of small corolla. Fruit a blue-black stone fruit, $\frac{1}{4}$ in. through; with stone grooved on one side and rounded on other.

Flowering time April through June. Fruits available for harvest from October through December. About 17,900 seeds per lb. used in nursery practice, or plant is propagated by cutting. It, like the maple-leaved viburnum, survives city smoke and so is popular as a city ornamental.

Plant also provides good cover for wildlife. Fruits known to serve as food for ruffed grouse and other birds and for chipmunks. If properly handled, makes a good full head of leaves and is therefore attractive. Straight new shoots good arrow-shaft material.

Black-berried Elder

Sambucus canadensis

Height to 10 ft. Stems coarse, light-colored when young, easily broken, white-pithed, with large lenticels, large buds, and a pungent odor when broken. Leaves opposite, of 5–11 but usually 7 leaflets, each to 5 in. long and with saw-toothed margins, paired, with the odd one at the end.

Native of North America. Found along roadsides, in moist spots in hedgerows or at edges of forests or marshes, in sun or out. From Nova Scotia to Florida, west to Texas and Manitoba as well as in West Indies. In North Carolina, found to elevation of 4,000 ft. About 25 species, of which half occur in North America.

Flowers borne in open, flattish-topped clusters that are to 6–8 in. across. Individual flowers white, to $\frac{1}{10}$ in. across, with 5 stamens, each about length of lobes of corolla and commonly alternating with those lobes. Fruit a deep purple to black stone fruit, with sweet pulp, to $\frac{1}{4}$ in. through, with roughened nutlets.

Flowers from June through July. Fruits available from August through October. Plant bears 4 years after seeds are sown, 175,000–468,000 seeds per lb. Grows well on coal-stripped lands where other plants will not grow. Fresh leaves, fruits, flowers, and roots yield hydrocyanic acid, which is destroyed with cooking.

Fruits are used to make excellent pies, wine, pancakes. Common food of grouse, quail, pheasant, dove, wild turkey, red squirrel, white-tailed deer. Leaves eaten freely by livestock. Stems used by pioneers in making spiles for collecting maple sap. Gives some cover as well as food to wildlife. Bark may be considered as poisonous.



Red-berried Elder



Teasel



Pumpkin

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Rubiales

Family Caprifoliaceae

Red-berried Elder

Sambucus racemosa

Height to 12 ft. Stems and twigs commonly covered with down. Twigs coarse, easily broken, showing a reddish pith in younger parts. Buds large, with a bluish tinge. Leaves opposite, compound, of 5-7 leaflets, rounded at base and pointed at free end, with fine saw-toothed margins. Leaflets to 5 in. long, stalked.

Native of North America. Found along roadsides and in rocky places from Newfoundland to Georgia, west to California and Alaska. In Virginia, it reaches an elevation of to 5,000 ft. Closely related to black-berried elder but these are not closely related to the black alder *Ilex*.

Flowers borne in somewhat cone-shaped but rather open clusters, not flat-topped as in black-berried elder. Clusters considerably longer than broad. Flowers white but become brown when they dry. Fruit a stone fruit that is red rather than blue or black, to 1/4 in. through, finely roughened nutlets.

Flowering time April through May. Fruits available June through November, or later into January. 48,300 seeds per lb. While red berries are generally considered poisonous, evidence is not conclusive.

A beautiful plant when in fruit so that a poet can speak of "the torching of red-berried elder" in a wholly justified expression of enthusiasm. Reputed poisonous qualities of fruit diminishes its popularity.

Family Dipsacaceae

Teasel

Dipsacus sylvestris

Height to 5 ft. or more. Stem stiff, erect, branching in upper areas, covered with conspicuous coarse prickles, somewhat angled, arising from a biennial root system that penetrates soil deeply. Leaves opposite, joined at base to make a cup, coarse, with prickles and toothed margins. Fall rosettes of leaves well-formed.

Native of Asia and of Europe. Naturalized in America. Well established from Maine to North Carolina, west to Michigan. Closely related to *D. fullonum*, the fuller's teasel used in carding wool in early days. Some 15 species in the genus native of the Old World; 2 established in America and 1 cultivated.

Flowers borne in terminal spikes that are essentially cone-shaped and conspicuous because of bristles. Flowers mature first in middle of spike and work up and down simultaneously from the middle. Corolla blue, lavender, or purple, to 1/2 in. long, 4-parted, with calyx tube fastened to it. Fruits dry, 4-sided, oblong, grooved on each face.

Flowering time July through September. Pollination by insects or by self. Crawling insects are unable to pass water pools at leaf bases but fruits are badly parasitized by other insects. Juice disagreeable to taste of cattle. Since it is biennial plant, can usually be controlled by plowing and clean cultivation.

A beautiful plant if one can look at it without prejudice. In fuller's teasel, the bristles are stiff enough to raise the surface of woolen cloth. The heads are split and mounted on belts or rollers that move over the cloth.

Order Campanulales

Family Cucurbitaceae

Field Pumpkin

Cucurbita pepo

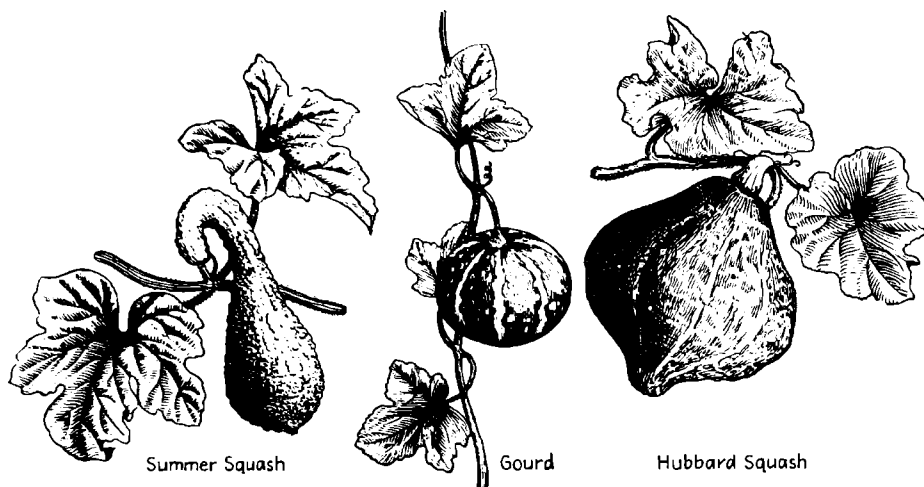
Vine. Stem prostrate, armed with stiff, harsh-feeling hairs, rather succulent and easily crushed. Leaves rigid, erect, stiff, to 1 ft. in diameter, with deep lobes separated by deep notches, unlike leaves of summer and winter squash, with hollow petioles that are harsh to the touch. Fruiting stalks 5-sided, swollen above.

Native of America. Found among relics of cliff dwellers. Some contend they are of Asiatic origin. Undoubtedly cultivated in America as early as 1500 B.C. Plants now growing wild in Texas resemble them. Summer squash is var. *condensa*; yellow-flowered gourd, var. *ovifera*, the latter being grown for ornament.

Flowers yellow, staminate flowers being without green globular base possessed by pistillate flowers. Corolla a great, flaring funnel, very narrow at base. Calyx with short, narrow lobes, generally not conspicuous. Fruit to 1 ft. or more in diameter, depressed sphere, with longitudinal ribs, yellow, white-seeded, with a medium-hard rind.

Seeds sown in rich soil, with good moisture, 6 seeds per hill, and hills 6 ft. apart, at depth of 1 in., thinned to 3 plants per hill and soil kept loose about plant. Downy mildew causes angular leaf spots controlled by bordeaux 3-6-50 when vines begin to run; powdery mildew making white leaf coatings controlled by later bordeaux application.

Commonly planted as supplementary crop with corn. Made into pies either fresh or canned. Fair source of vitamin B and one of the essentials of a successful Thanksgiving dinner. Also popular with youngsters as the basic material for jack-o-lanterns for use at Halloween celebrations. Stored successfully at temperatures between 50-60°F. Raised for cattle food.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Cucurbitaceae

Summer Squash
Cucurbita pepo condensa

Common name bush pumpkin implies lack of the long running vines of the typical pumpkin; varietal name further implies a compact plant. Otherwise it is very similar to the ordinary pie pumpkin in shape of leaves. Ordinarily not a tendril bearer. Annual.

Native of America and developed in many forms, with many different shapes and qualities. Among the types recognized are the pattypan, the scallop, and the summer crooked neck. Pattypanns are sometimes considered as yellow or white bush scallops.

Flower much like that of pumpkin, yellow, funnellform, with stem jointed where it joins fruit and expanded at that point. Staminate flowers without swollen base characteristic of pistillate flowers. Pollinated by insects. Cross-pollination between type and variety is easily possible but undesirable.

Sow in garden soil, in hills about 4 ft. apart, 6 seeds per hill, at depth of 1 in. after danger of frost has passed. Thin seedlings to 3 plants per hill and keep soil loose about plants. Fruits are picked when ready to use and not allowed to ripen on vine or after. Pests similar to those of pumpkin.

Pumpkins and squash should not be planted close together as fruits resulting from crosses are not desirable. Summer squash commonly cooked when fruits are young and before rind has started to harden. Summer squash not so easily stored as winter squash. Yield a fair amount of vitamin B.

Yellow-flowered Gourd
Cucurbita pepo ovifera

Vines, long and running as in typical pumpkin, slender, often climbing, tendril-bearing. Leaves much like small pumpkin leaves but more deeply lobed or scalloped.

Native of North America. A variety of typical pumpkin, with vines and leaves much like typical species. Many subvarieties based on size, shape, and color of fruit and on other characteristics. So varied are these gourds that some interesting studies in genetics have been made from them.

Flowers similar to those of pumpkin and summer squash but smaller than either. Flowers apparently require sun to succeed and so should be grown in exposed places. Fruits much smaller than either pumpkin or summer squash, with a brittle hard rind; when dried, they can withstand much abuse.

To succeed, these plants must have an abundance of water during the growing period. Seeds should not be planted until all danger of frost has passed and usually they are not planted in hills but near some tall support. Gourds are grown principally for their hard shells used as ornaments, cups, pails, birdhouses, and other things.

Some related gourds have unique uses, as the dishcloth gourd whose young edible fruit is baked or boiled and eaten while the fibrous center serves as a dishcloth or bath sponge. Many gourds have holes bored in them, their interiors removed, and pebbles or shot inserted so they may be shaken as rattles for primitive music.

Winter Squash
Cucurbita maxima

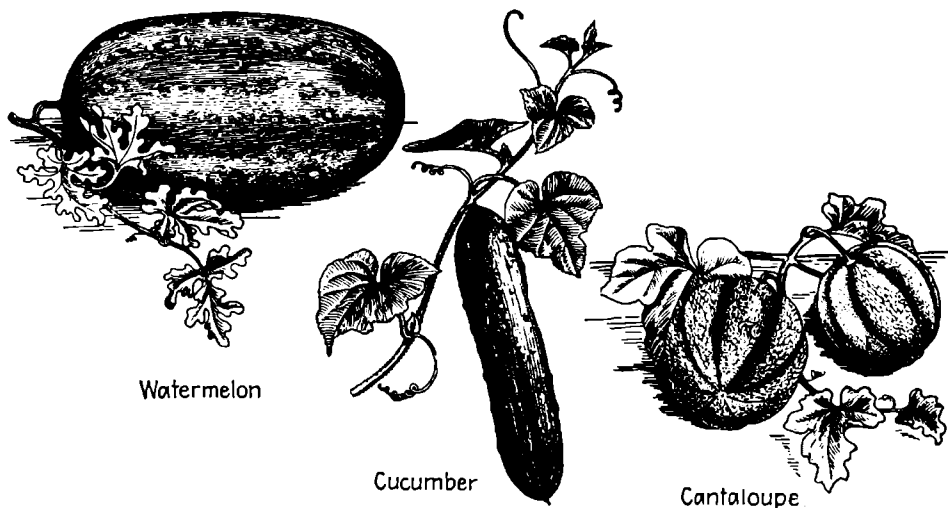
Vines extending to 20 ft. or more, soft and not harsh as in pumpkin. Leaves with lobes rounded rather than pointed as in summer squash. White spots are supposed to be absent from leaves of winter squash though this is also often true of the pumpkins and summer squash. Leaves not rigid. Annual.

Native of Americas. Includes many radically different varieties such as mammoth Chile with enormous fruits sometimes exhibited as pumpkins, Boston marrow squash, Hubbard squash, and turban squashes. An essential botanical difference between this plant and pumpkin is that it lacks swollen end of supporting fruit stem.

Flowers with broad backward-bending lobes spreading from a tube that has more parallel sides than in pumpkin or may be swollen at base. Fruit stalks soft and yield easily to fingernail, unlike hard stalks of pumpkin and summer squash. Seeds white or brown, with slanting scar, and margin colored like rest of seed.

Seeds planted in hills, often with other crops such as corn, and thus require no extra land or cultivation. Hills may be 6 ft. apart, with seed 6 to a hill and seedlings thinned to 3 per hill. Plants sometimes started in boxes and transplanted. They do not require a long season and do well on a variety of soils.

Hubbard and other winter squash are usually baked and soft inner rind or pulp eaten direct from shell. Plant subject to many insect and fungous enemies, among worst of which is a wilt. Winter squash store better than other similar fruits and sweeten with storage because of change of starches to sugar.



Watermelon

Cucumber

Cantaloupe

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Cucurbitaceae

Watermelon
Citrullus vulgaris

Stem a long, running vine with branched tendrils, hairy but not brash as in pumpkin and summer squash. Leaves with 3-4 pairs of lobes, with heart-shaped base, to 7 in. long, smooth or hairy but not rough. Annual. Vines may be so extensive as to cover a field with their branches.

Native of tropical Africa where it grows voluntarily in some places. Has been under cultivation for centuries in India and Egypt; is shown in early Egyptian paintings and described in Sanskrit. Of 4 known species, 3 are African and 1 Asiatic.

Flowers small for such a large fruit, being about $1\frac{1}{2}$ in. across, of 5 lobes divided nearly to base, light yellow, usually borne singly in leaf axils. Fruit weighs to 50 lb. or more, striped with light and dark green, with hard but sensitive rind, red watery flesh, and black or white seeds. Stamens and pistils in separate flowers.

Seeds planted in hills 5-7 ft. apart, 1 in. deep, 4-10 per hill, after danger of frost has passed. Seedlings thinned to 2-3 per hill. Requires deep rich soil and 90-100 days to mature fruit. Attacked by anthracnose, powdery mildew, and striped cucumber beetle. Plants often sprayed and netted in protection.

An excellent fruit for eating fresh, in preserves, or otherwise. The variety *citroides*, the citron, has a white, more solid flesh and a high pectin content and is used in jams, jellies, and preserves. Watermelons constitute an important agricultural crop in the Middle West as they stand shipment rather well when harvested properly.

Cucumber
Cucumis sativus

Vine with stems angled, trailing or climbing, tender, rough and hairy, with simple unbranched tendrils that help vines climb on trellises or over other plants. Leaves to 6 in. long, somewhat 3-lobed, about as wide as long, very rough to touch, easily crushed, rather long-petioled. Roots fibrous. Annual.

Native of southern Asia. Introduced throughout world where climate is suitable or grown anywhere in greenhouses. English forcing cucumber is a var. *anglicus* and the bur gherkin and muskmelon are related species *anguria* and *melo*, respectively. About 30 species and many varieties known to the genus.

Flowers either staminate or pistillate, to about $1\frac{1}{2}$ in. across, with corolla lobes acute, with many staminate flowers often closely clustered but the pistillate commonly borne singly. Seed to seed in 65-90 days. Fruit somewhat prickly, oblong or elongated, yellow when mature, with small flat white seeds and wet pulp.

Seeds planted in hills to 6 ft. apart. Seedlings thinned to 3 plants per hill. Soil kept loosened. In greenhouses, pollination by hand may be necessary. In fields and gardens, fruits picked green, not allowed to mature on vines. 1 oz. of seed enough for 50 hills; 1 plant may yield 100 cucumbers weighing 50 lb. per bushel.

An important food plant of garden and greenhouse. Possibly fair as source of vitamin B but yields little A or C. 1 lb. yields 68 food calories and 0.39 oz. of carbohydrate; 1 acre may yield to 100 bushels of pickling cucumbers. Fruits made into pickles or preserved when ripe or eaten fresh and green.

Muskmelon, Cantaloupe
Cucumis melo

Vine. Climbing, sprawling, and trailing, with ridged or angled stems covered with soft hairs. Leaves to 5 in. across, nearly round, not distinctly lobed, but with margins shallowly and broadly toothed; hairy and somewhat roughened, petioled, definitely blunt at free end. Annual.

Native probably of central Asia. Grown widely in fields and gardens where conditions are suitable. 3 major American groups include nutmeg or netted melons of var. *reticulatus*, winter or cassaba melons var. *inodorus*, and cantaloupe melon var. *cantalupensis*. Name cantaloupe erroneously applied to netted melons.

Flowers about 1 in. across; stamens grouped in more than 1 axillary flower, pistillate usually borne separately in an axil. Corolla margins like rounded teeth. In greenhouses, pollination is by hand. Fruits of many varieties with fragrant yellow, green, or flesh-colored inner rind, musky in odor. Mature in 90-100 days.

Grown usually in relatively dry areas or in greenhouses, 1 vine yielding 3-4 mature fruits. Seeds planted in hills to 6 ft. apart, thinned to 3-4 per hill, cultivated like other melons. Little danger of cross-pollination with others. Striped cucumber beetle, worst pest, controlled by sprays and netting.

1 lb. of pulp yields 180 food calories; only about $\frac{1}{2}$ purchased weight is useful. Fair as source of vitamin B. Used chiefly as appetizer. Now being quick-frozen for sale at any time of year. By forcing young plants in greenhouses, crop for November harvest may be planted in July. Should be dry during ripening season.



Squirting Cucumber



Canterbury Bell



Cardinal Flower

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Campanulales

Family Cucurbitaceae

Squirting Cucumber *Echinocystis lobata*

Climbing, tendril-bearing vine, sometimes to 25 ft. long but weak, slender, smooth, branched, angular, grooved, and sometimes with hairs at joints or near them. Leaves borne on petioles, to 3 in. long, thin, 3-7-lobed to form an obscure irregular star with pointed lobes.

Found in moist waste places such as wet lowlands climbing over other vegetation, sometimes forming a considerable mass. Ranges from New Brunswick to Virginia, west to Manitoba, Kansas, and Texas. Found sometimes in wild gardens where it may have been introduced as a semiornamental.

Stamens and pistils in separate flowers on the same plant, the former abundant, in rather long, loose open clusters; the latter, borne either singly or in pairs. Fruit to 2 in. long and about half as thick, spongy, covered with weak spines, capable of expelling seeds.

Aside from the rather attractive nature of the plant, the most interesting feature is probably the expulsion of the seeds from the fruits. Seeds flat, pointed at one end, bluntly rounded at other, brown and few in number. Flowering time from June through September, followed immediately by fruiting.

Of little economic importance since the fruits are not edible and the plants are not outstandingly attractive, nor are they destructive of the plants on which they may rest for support. Common names include creeping Jennie and wild cucumber.

Family Campanulaceae

Canterbury Bells *Campanula medium*

Height to 4 ft. Stem erect, hairy, relatively stout, covered with fine bristly hairs. Leaves, those of base to 10 in. long, with long tapering petiole-like base; those of upper stem to 5 in. long, with clasping bases and wavy margins. Biennial.

Native of southern Europe but grown rather widely in many parts of world as a garden ornamental. Some 250 species of genus found for most part native in Northern Hemisphere. Of course many varieties have been developed with varying colors of flowers and time of flowering.

Flowers borne in a long terminal stalk, singly or in 2's along stalk. Corolla like an inflated bell or vase, with tube to 1 in. in diameter and lobes spread wide or bent backward, violet, blue, pink, white, or other colors. Calyx with its lobes about $\frac{1}{4}$ corolla length. Fruit a 5-celled capsule.

Seeds sown in open to produce flowers succeeding year or started indoors in early spring so that seedlings may be transplanted by early May to flower both first and second year. Seedlings from summer-planted seeds may be taken up in fall to be potted for winter blooming indoors.

This species is possibly most popular of this group of plants. Among many varieties are some with calyxes colored like corollas or with corollas broadly flaring or with corollas more truly bell-shaped than is case with typical species. Unfortunate that plant is not perennial.

Family Lobeliaceae

Cardinal Flower *Lobelia cardinalis*

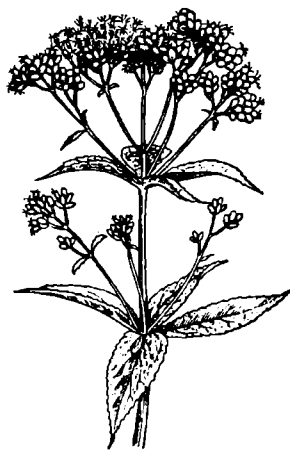
Height to 4½ ft. Stem erect, not commonly branched, smooth or with some down, well-supplied with leaves. Leaves alternate, thin, green, smooth or somewhat downy, conspicuously veined, to 6 in. long and to 1½ in. wide, with clasping bases and wavy margins. Perennial offshoots appear at season's end.

Native of North America. Found in wet or moist soils from New Brunswick to Florida, west to Texas, Colorado, and Ontario. Some 250 species in the genus found widely distributed over the world but with about 30 to be found in United States. Unfortunately, being gradually eliminated.

Flowers borne largely from near top of stems, numerous, and on short individual stems, with corollas to 1½ in. long, with lower lip of 3 relatively distinct lobes and the tube itself about 1 in. long, brilliant scarlet or rarely white. Bracts at base of flowers usually glandular.

Flowering time July through September, and when abundant plant provides a spectacular sight. Pollination is largely by hummingbirds or more rarely by bumblebees, latter having difficulty in clinging to weak, split lower lip of corolla, but former able to probe flower without alighting.

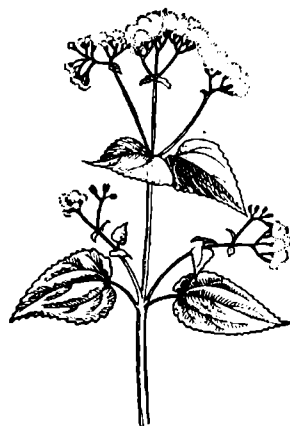
This flower should receive protection against promiscuous collectors at all times. For years, Life Camps taught an excellent lesson with this plant having one growing at public drinking fountain with no sign to protect it but with a well-established public opinion enlisted to maintain its safety.



Joe-pye Weed



Boneset



White Snakeroot

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Joe-pye Weed
Eupatorium purpureum

Height to 10 ft. Stem erect, smooth or downy, branched or unbranched, green or bluish, round or ridged. Leaves opposite, or more commonly in whorls of 3-6, rather long-petioled, with saw-toothed margins, to 1 ft. long and to 3 in. wide, smooth or downy.

Native of North America. Found at edges of marshes or in other wet places, and in wet wastelands from New Brunswick to Florida, west to Texas and Manitoba. Belongs to tribe *Eupatorieae*, whose heads are in discs and whose flowers are all perfect and tubular. Over 500 species in the genus.

Flowers in numerous, more or less cylindrical heads with pinkish or bluish outside bracts and with enclosed flowers pinkish, bluish, purple, or sometimes white. Fruit with about 5 angles, crowned with rough bristles. Normal reproduction by means of wind-distributed fruits.

Flowering time August through September. Fruits found on dead tops of plants on into winter. As a weed, plant is not a serious pest since it yields readily to cultivation or to drainage. Usual procedure is frequent mowing where control is necessary.

An attractive marsh plant that figured in early pioneer medicine but has no recognized merit in the modern drug trade. Many common names attest its general familiarity as motherwort, niggerweed, skunkweed, gravelroot, boneset, purple boneset, kidneyroot, and king of the meadow.

Thoroughwort, Boneset
Eupatorium perfoliatum

Height to 5 ft. Stem branched in upper areas, pale green, hairy, stout, ridged, erect. Leaves opposite, joined at base so that they seem to be pierced by stem, hence *perfoliatum*, widest at base, tapering evenly to tip, to 8 in. long and to 1½ in. wide, with finely toothed margin, pale green.

Native of North America. Found commonly in wet meadows, marshes, and wastelands. From Nova Scotia to Florida, west to Texas, Nebraska, and Manitoba. This species and others here treated are members of subgenus *Eupatorium*, characterized by having bracts of head enclosure (involucre) unequal.

Flowers in closely arranged heads, with 10-40 flowers in each head and heads to ¼ in. long. Bracts enclosing head are unequal in length, are pointed and are in 2-3 series. Corolla tubular, white or blue. Fruit 5-angled, black or brown, with yellowish dots, crowned with hairy parachute.

Flowering time July through September. Fruits may be shed from mid-fall on into winter. Plant perennial but not persistent and cannot survive drainage, repeated cultivation, or hoeing. Leaves contain the glucoside eupatorin used in medicine as a tonic or stimulant or, in large doses, as an emetic.

Plant had widespread use medicinally in early days and is still recognized as having some merit. Dried leaves and tops yield fluidextract, of which 30 gr. is considered an average dose. Raised as a drug plant it yields 1 ton of dry herb per acre worth to 10 cents per pound, although demand is limited. Other names include agueweed, boneset, Indian sage, crosswort.

White Snakeroot
Eupatorium rugosum (urticaefolium)

Height to 4 ft. Stem erect, smooth, somewhat sticky, much-branched, relatively slender. Leaves opposite, much like those of nettle, hence *urticaefolium*, to 6 in. long and to 3 in. wide, with petioles to 2½ in. long, conspicuously veined, with saw-toothed margins, turning conspicuously dark to black with the first frost.

Native of North America. Found in woodlands where the soil is rich. From New Brunswick to Florida, west to Texas, Nebraska, and Minnesota. It, like the others here mentioned, belongs to the subgenus *Eupatorium*. Plant is one of the conspicuous plants of many woodlands in late summer and fall.

Flowers in heads, arranged in a flat-topped formation, with from 8-30 flowers in a head, each bearing pistils and stamens. Corolla conspicuously white so that en masse plants may give woodlands appearance of being smoke-filled. Bracts of involucre that encloses each head are about equal to each other. Perennial.

Flowering time July through November. Leaves and stems contain poisonous alcohol tremetol, which is soluble in milk fat. Cattle eating this may yield poisonous milk, causing milk sickness to both cattle and man. The cattle tremble, are depressed, constipated, and nauseated, have labored respiration, and stand with difficulty.

Milk sickness in man may cause weakness, nausea, vomiting, stomach pains, thirstiness, dry skin, constipation, slow pulse, slow respiration, low body temperature, weakness, collapse, and in some cases death. Cattle eat plants usually only when other forage is not available.



Tall Ironweed



Blazing Star



Gumweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Campanulales. Family Compositae

Tall Ironweed *Vernonia altissima*

Height to 10 ft. Stem erect, smooth or practically so, freely branched in flower-bearing portion, relatively slender. Leaves alternate, smooth on both sides, to 1 ft. long and to nearly 2 in. wide, with shallow saw-toothed margins and rather conspicuous veins, pointed at each end, with suggestion of petiole at base.

Native of North America. Found in moist, rich soils, mostly in open from New York to Florida, west to Louisiana, Kentucky, and Michigan, with range extended farther west by closely related species. Over 500 species of genus of wide distribution in temperate areas but most abundant in South America.

Flowers borne in heads of 15-30 flowers, all tubular, all bearing stamens and pistils, to $\frac{1}{4}$ in. across, with bracts of involucre enclosing heads of varied length, with shortest to outside. Fruit dry, crowned with parachute of bristles arranged in 2 rows, with outer row shorter than inner. Bristles, purplish.

Flowering time July through September. In full fruit, shows rather conspicuous purplish top. Ironweeds of one species or another are rather conspicuous in late summer and fall prairie flora through much of the Middle West. They are not so evident in the East.

Classified as a weed but not as a serious one since it yields readily to control measures such as plowing and cultivation. Plant is recognized as being a valuable nectar producer by beekeepers who have resented its destruction along roads and railroad right-of-ways. In this respect, it is like its close relatives the eupatoriums. A standard indicator of overgrazing.

Tall Blazing Star *Liatris scariosa*

Height to 5 ft. Stem erect, rather stout, usually unbranched even in the flowering portion. Leaves deep rich green, alternate, hoary, narrow, to 6 in. long and to $\frac{1}{2}$ in. wide, entire, with upper even proportionately more narrow than lower, usually somewhat resinous. Root system corm-like and substantial.

Native of North America. Found in open prairie country widely spread from Maine to Florida, west to the Rocky Mountains and into southern Canada. It favors dry soil. The genus is often referred to as *Lacinaria*. About 35 species in the genus native of eastern and central North America.

Flowers borne in not too crowded heads along upper portions of erect stem, heads being hemispheric, to 1 in. across, composed of 15-45 flowers, with brilliant magenta purple corollas. Bracts of enclosing involucre may be in 5-6 series and parachute that crowns fruit of finely barbed bristles.

Flowering time from August through September. Any attempt to describe prairie flora for this period without reference to one or another of the species of this genus is inadequate. Some of the species are grown as garden ornamentals. Of these, *L. elegans* and *L. pycnostachya* are most popular. Division of underground parts is a common propagation practice.

Difficult to understand why this plant is not more widely grown as an ornamental. Has many common names such as gray feather, blue feather, rattlesnake master, devil's-bite, button snakeroot, blue blazing star, and so on. This species is here chosen in part because of its distribution, not because it is the most beautiful. It is not.

Gumweed *Grindelia squarrosa*

Height to 2 ft. Stem erect, branched, smooth, commonly with reddish cast. Leaves alternate, with clasping bases, rigid, roughened, to $1\frac{1}{2}$ in. long and to $\frac{1}{2}$ in. wide, with sharply-toothed margins, widest in upper half, with the lower commonly narrowed at base into petiole. Root system a substantial vertical rootstock with branches.

Native of North America. Found in open dry pastures and meadows from New York to Pennsylvania, west to Texas, Arizona, and Mexico and to Manitoba. Not abundant in the eastern portion of this range but a common prairie plant through Middle West.

Flowers borne in heads that usually have distinct tarry or gluey feeling outside where bracts of involucre are narrow and pointed with free ends spread back. Flowers in heads are of 2 kinds, with outer ray flowers bearing pistils only and inner ray flowers with both stamens and pistils. Ray flowers to 1 in. long, or absent.

Flowering time June through September, so it is a long-season plant. Fruits bear 2-3 rather stiff awns at top rather than any abundant parachute. Plant may be considered a seriously poisonous forage for grazing animals in regions where there is selenium in the soil. In other regions, it is harmless.

Plant is considered by range managers a good index of overgrazing. Management calls for hoeing or cultivating the plant before fruits form. It yields rather well to plowing and cultivation, so a crop rotation with open cultivated plants in the cycle serves as a good check. This of course may be impractical in range management.



Goldenrod



Late Goldenrod



Silverrod

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Canadian Goldenrod
Solidago canadensis

Height to 5 ft. Stem erect, slender, smooth or downy above, somewhat angled or ridged. Leaves definitely 3-nerved, with branching veins, to 5 in. long and $\frac{1}{2}$ in. wide, with shallow saw-toothed margins, narrowed at either end or the lower ones with petioles.

Native of North America. Found from Newfoundland to Virginia, west to Tennessee and Saskatchewan. Not ordinarily found bordering salt water. Goldenrods, asters, gumweeds, and others here considered belong to the tribe *Astereae* whose flower heads have flat smooth styles.

Flowers borne in small heads, erect on arching to horizontal upper branches, composed of 4-6 yellow short ray flowers with bracts of enveloping involucre pointed at tip, thin and narrow. Fruit crowned by many slender, equal, hair-like bristles.

Goldenrods are the State flowers of Nebraska, North Carolina, Alabama, and Kentucky but it is doubtful which species is meant in some cases. Goldenrods have been imported into London with the thought that they could heal wounds.

It has been proposed that since goldenrods of one sort or another are to be found conspicuously and widely distributed over America, they should be our national flower. Unfortunately, this might be taken to mean that we worship gold and the idea has not won favor. They are considered to cause hay fever.

Late Goldenrod
Solidago serotina

Stem erect, to 8 ft. high, smooth or sometimes with a bloom, somewhat irregularly ridged. Leaves with 3 main veins, with sharply but very shallowly cut margins, to 6 in. long and to $1\frac{1}{2}$ in. wide, the lower with petioles, smooth on both sides or finely downy on the underside.

Native of North America. Found from New Brunswick to Georgia, west to Texas, Utah, and British Columbia, reaching an elevation of 2,300 ft. in Virginia. It favors moist meadowlands. Of about 125 species, almost all are natives of North America with only 3-4 outside our continent.

Flowers borne in relatively small heads, arranged usually along upper side of arching upper branches to form wand-like structures. Heads are to $\frac{1}{4}$ in. high and the bracts of the enclosing involucre are blunt and rather thin. About 7-15 flowers in each head.

State flower of Nebraska. This species does not survive cultivation although it is perennial and persistent if undisturbed. Formerly, goldenrods were thought to yield wound-healing juices but this is not considered a valid assumption at present.

Some goldenrods have a place as ornamentals in wild-flower gardens. 2 species of 24 eastern species have been found to contain sufficient latex in the juices of their leaves to warrant their improvement as a possible source of rubber.

Silverrod
Solidago bicolor

Height to 4 ft. Stem usually unbranched but not always so, erect, often densely hairy but sometimes almost smooth, rather stout for a goldenrod. Leaves alternate, to 4 in. long and to 4 in. wide, widest at free end with base of lower leaves definitely narrowed into a winged petiole, usually downy.

Native of North America. Found in dry soil, frequently in the shade of woodlands or in some thickets, not so common in open sunshine. From mouth of the St. Lawrence to Georgia, west to Tennessee and Minnesota. In North Carolina, found to 6,300-ft. elevation.

Flowers borne in clusters of heads arranged in alternate groups along upper portion of stem. Heads to $\frac{1}{4}$ in. high, with ray flowers white instead of usual yellow of a goldenrod and with bracts of involucre that encloses the head whitish and helping to give the name silverrod. Fruits smooth.

Blooms from July through September. Rarely appears in lists of wild flowers though it has a beauty of its own. Not a weed in strictest sense nor does it apparently have medicinal or commercial possibilities. Its common names include bellyache weed, from the assumption, probably false, that it either caused or cured that malady.

It is just as dangerous to assume that all goldenrods cause hay fever as it is to suppose that none of them do. They do bloom at the time when less conspicuous but more virulent ragweed is at its height and they are blamed for much hay fever that other plants may cause.



Floss Flower,
Ageratum



European Daisy



China Aster

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Flossflower

Ageratum houstonianum

Stems relatively weak, to about 1 ft. high or sometimes higher and forming an open loose mass. Leaves blunt or rounded at base. In *A. houstonianum*, leaves are heart-shaped at base. Leaves mostly opposite and with distinct petioles. Roots fibrous and much-branched.

Native of Mexico. Hardy ageratum belongs to a related genus. Of about 30 species, native herbs of tropical America, only 2 appear commonly in greenhouses or gardens. Favor loose relatively rich well-drained soils and withstand heat well.

Flowers tubular, blue, rarely pink or white, and in heads $\frac{1}{4}$ in. across or less. In *A. conyzoides*, the heads are commonly under $\frac{1}{4}$ in. across. Flowers fragrant, long-lasting, always attractive. Flowers all summer, or until frost comes. If protected, it is perennial.

Propagated by cutting to get early blooms or by seeds planted indoors in late March or outdoors after danger of frost has passed. In greenhouse, blooms profusely through winter. Flowers must be kept picked if blooming is to be prolonged. Worst pests are aphids, red spider, and thrips. Difficult to keep varieties true, so it is a gamble what may be expected from most seed. Tall and short strains seem to be more permanent.

Seeds sown in February produce marketable plants in 4-in pots by May at 50°F. Pinching off ends develops bushiness. One of most popular plants for growing in hanging baskets and window boxes, where they are grown with geraniums, wandering Jew and coleus. Finds ready sale at a low price.

European or Garden Daisy

Bellis perennis

Practically stemless. Appears as flat compact tufts of leaves, all of which of course are basal. Leaves to 2 in. long, obviously narrowed at the base into petioles, downy to hairy, widest toward free end, with margins only slightly broken. Root system perennial and substantial.

Native of Europe but established rather widely in America, appearing usually as patches in lawns either in shade or sun. Found here most commonly in the Northeast from Nova Scotia to Pennsylvania, west in broken areas to California and British Columbia. Also native in Asia.

Flowers borne in crowded heads on ends of short scapes or stems; one head to a scape, to 1 in. broad. Ray flowers many; either white, purple, or pink, while bracts of involucre that bind flowers of head are usually purple. Flowering period April through November.

Probably introduced with grass seed. Once established, may spread over small patches excluding all other plants. Rarely however do they take over a whole lawn. At least 11 well-defined races have been identified in this daisy but they do not justify varietal status.

This is the true English daisy, not closely related to ours (see page 335). It has many common names such as ewe-gowan, May gowan, childing daisy, herb Margaret, March daisy, bairnwort, bonflower, white daisy, and lawn daisy.

China Aster

Callistephus chinensis

Stems erect, to 2½ ft. high, branching, with slightly sticky short stiff hairs. Leaves broadly triangular to egg-shaped, deeply and irregularly toothed, the upper being narrower than the lower and without stalks common on lower. Roots fibrous.

Native of China and Japan. Cultivated in Europe more than 200 years; in America more than 100 years. Grows best in rich, sandy loam either in full sunshine or in part shade. Well-decayed manure makes best fertilizer. Favors temperate climate.

Flowers in terminal heads, showy, single or double, large or small, in tints of pink, blue, and white. Early-flowering varieties sown in July, benched in late August, mature in January if 5 hours of additional light is added each day by 50-watt lamps spaced at 4 ft., and raised 18 in.

Sow in March; transplant to get early bloom; or sow outdoors in May, for September bloom. Cover seeds $\frac{1}{2}$ in. deep. Thin plants to 18 in. apart, cultivate lightly and frequently, add lime if soil is sour, keep fertilizer from direct contact with roots. Seeds germinate in 8 days; live 3 years. Spray with kerosene emulsion for tarnished plant bug. Mix nicotine duct in soil to control root lice. Knock off blister beetles into can of kerosene. Dig and burn plants attacked by yellows, wilt, or rust. Yellows not common under glass but leaf hoppers may be serious pest here.

Valuable and popular cut-flower plant grown best in greenhouses where cost of suggested extra lighting should be about 1 cent per flower at 3 cents per kilowatt-hour. Keeps best after cut if cut ends are in 2% sugar solution instead of in water. Marketed usually in bunches of 25.



Large-leaved Aster



New England Aster



Wild Heath Aster

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Large-leaved Aster
Aster macrophyllus

Height to 3 ft. or sometimes more. Stems coarse, rough, angular, reddish and rarely straight, arising from a long thick rootstock. Leaves basal, like huge pointed hearts, on long petioles, with 3-4 to a stem, to 1 ft. or more long, rough above and generally harsh to the touch.

Native of North America. Found in relatively open woodlands or shady dry areas. From southeastern Canada to North Carolina, west to Minnesota. A number of different races have sometimes been given varietal standing by different writers but others group them all under this species.

Flowers in relatively large heads that are usually widely separated, to $\frac{1}{2}$ in. high, with about 16 pale lavender, violet, or almost white ray flowers over $\frac{1}{2}$ in. long surrounding the smaller tubular perfect yellow disc flowers of the center.

Flowering time August into early September, making plant a relatively early species. Leaves appear early in spring and remain late; since they are so large, they often make a conspicuous part of woodland ground flora. When completely mature, disc may be reddish-brown.

Young leaves of this aster are sometimes used as herbs comparable to dandelion and spinach. They become too rough to be generally popular and should ordinarily find favor only when they are young and fresh. Even then, they can hardly rival other sources of food usually available.

New England Aster
Aster novae-angliae

Height to 8 ft. Stem branched, stout, with abundant sticky stiff hairs well covered with leaves. Leaves entire, to 1 ft. long and nearly half as wide, thin, a rich dark green, more or less uniform in width, pointed at free tip. Root system perennial, horizontal, and substantial.

Native of North America. Found often most abundantly along edges of swamps or roadsides or in neglected fields. From Quebec to South Carolina, west to Alabama, Colorado, and Saskatchewan. Some 250 species in genus, of which more may be native of North America than of other continents.

Flowers borne in heads at ends of or near ends of uppermost branches, erect for most part, with 30-50 brilliantly colored ray flowers that are slender, to $\frac{3}{4}$ in. long, usually bright violet-purple, pink, red, white, or rose, with pistils but no stamens, and tubular yellow disc flowers that have both stamens and pistils.

Time of flowering August through October, at which time they may give their surroundings a color effect that may well rival maples at their best. Fruits freed to winds from September through November. May be starved by repeated cutting. Cultivation immediately eliminates it as a possible weed.

Too beautiful to be destroyed if area it occupies is not needed by other plants. While it yields no important medicinal elements and it is not considered a good forage for domestic stock, yet it adds beauty to its surroundings and provides welcome cover to many small wild game animals.

Wild Heath Aster
Aster pilosus

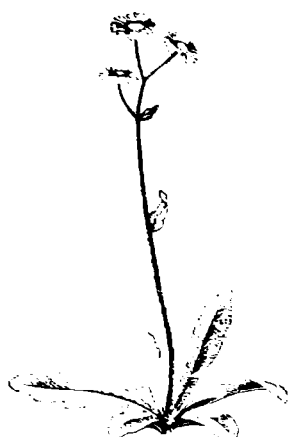
Height to 3 ft. Stem widely branched, slender, tough, smooth or downy, making a bush-like top to the plant. Leaves: basal or stem ones, to 3 in. long and to $\frac{1}{4}$ in. wide or with base a long-drawn-out petiole and free end relatively blunt; uppermost leaves, narrow and relatively short and dry.

Native of North America. Found in one or more forms from southeastern Canada and Maine to Florida, west to Missouri and Minnesota. As a rule asters of this group do not provide any valuable forage to the territory in which they may grow.

Flowers in numerous small heads to about $\frac{1}{2}$ in. broad, with from 15-25 rays that are white or tinged with rose and are pistillate; with smaller number of yellow, tubular disc flowers that bear both stamens and pistils and produce fertile seeds. Parachute that bears mature fruit is white.

Flowering time September through December, making plant one of late-blooming asters. Not uncommon to find good flowers of this plant in perfect bloom in protected areas even after first snowfall. Some aster relatives of the West, such as *A. parryi* and the alkali aster *A. glabriuscula*, are believed to poison sheep.

Some asters provide good grazing for elk, deer, horses, and sheep while others are of practically no importance. A few as suggested above are poisonous. On the whole, asters are merely good to cover land with a degree of beauty all their own.



Robin's Plantain



Daisy Fleabane



Horseweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Robin's Plantain
Erigeron pulchellus

Height to 2 ft. but usually lower. Stem usually unbranched except in flowering portion, densely covered with hairs arising from a perennial rootstock or from prostrate stems that help spread plant. Leaves mostly basal, to 3 in. long and to 2 in. wide, short-petioled, hairy, and usually almost entire.

Native of North America. Found from Nova Scotia to Florida, west to Louisiana, Kansas, and Minnesota. A member of the subgenus *Euerigeron* and like *E. philadelphicus* perennial, with leaves almost entire. Unlike *E. annuus* and *E. ramosus*, which are usually annuals.

Flowers borne in relatively large beautiful heads that are to 1½ in. across while heads of *E. philadelphicus* are rarely to 1 in. across. Ray flowers abundant, narrow, purple, violet, or blue and contrast with greenish-yellow disc flowers that form a flat center of the head.

Flowering time April through June, while that of Philadelphia fleabane is from April through August. This may provide a simple superficial way of separating the two at least in late summer. Propagated by seeds and by stem offshoots that develop at base of clusters.

A beautiful flower that might find a place in a flower garden if it were not considered as a weed. Since it yields readily to almost any control measure, it is difficult to consider it at any time as a serious weed pest. Hoeing the crowns is an effective means of destroying a thing of beauty.

Whitetop, Daisy Fleabane
Erigeron annuus

Height to 5 ft. Stem erect, stiff, slightly ridged, greatly branched in upper areas, sparingly hairy, with hairs spreading. Leaves alternate; the lower, to 6 in. long and to 3 in. wide, with a petiole and rather coarse marginal teeth; the upper usually without petioles, narrower, often nearly entire.

Native of North America, established from there in Europe, Bermuda, and probably other parts of world. Found from Nova Scotia to Georgia, west to Missouri and Alaska. It grows in common roadsides and waste places usually thought of as ideal for what we call weeds.

Flowers borne in numerous heads at tips of uppermost branches, heads being "daisy-like," about ½ in. across, with ray flowers essentially uniform in width throughout their length as with other erigerons; unlike asters in this respect. Rays white or tinged with purple. Annual. Parachute on fruits, double.

Flowering time May through November. Fruits from June to end of year. Sheep reputed to favor white-top over good grass hay and if turned into a field will destroy the fall rosettes that may have developed from early seedings. Ordinarily plants should be destroyed at first blooming.

Fields badly infested with this plant may be cleaned by plowing and sowing to winter wheat, following this with a clean-cultivated crop. Known as lace buttons, tall whiteweed, and sweet scabious. In spite of fact that sheep favor it as a food, farmers do not recognize it as a valuable forage plant.

Horseweed
Erigeron canadensis

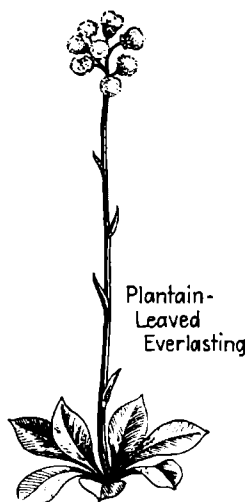
Height to 10 ft. Stem densely covered with rather stiff hairs or smooth, much-branched at top with branches commonly turning upward. Leaves alternate, the lower to 4 in. long, blunt, broadest near tip, entire or obscurely notched, while upper leaves are much narrower. Annual.

Native of North America and found over all of North America except in extreme north. Widely distributed in Asia, Europe, South America, and West Indies. Over 150 species of the genus, of wide geographic distribution. Common in fields and waste places generally.

Flowers borne in small, rather widely separated heads, numerous, about ⅓ in. across, enclosed by a rather compact involucre of slender, smooth, sharp-ended bracts. Ray flowers short, white, numerous but relatively inconspicuous, with flat part shorter than tube that bears it.

Flowering time June through November. A drug from this plant produces a dermatitis, smarting eyes, sore throat, and prostration. It is a diuretic, tonic, and astringent, used in treating chronic diarrhea and certain types of hemorrhage. Dermatitis is most commonly observed in those who handle the dry plant as hay.

Name horseweed probably comes from fact that plant is abundant in horse pastures. Others contend that farmers formerly rubbed their horses down with it, but it may affect some animals as does poison ivy. Controlled by repeated cutting, by burning to destroy the fruits, or by growing an open cultivated crop.



Pearly Everlasting



Low Cudweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Plantain-leaved Everlasting
Antennaria plantaginifolia

Height to 20 in. Stems sprawling from a crown, with ascending leaf-bearing tips, more or less erect, crowned with flowering heads, either stout or slender, hairy or not. Leaves 3-ribbed, to 3 in. long and to 1½ in. wide, dull dark green above, silvery beneath. Perennial.

Native of North America. Found on dry soil particularly in open hilly woodlands from Labrador to Georgia, west to Texas, Nebraska, and Minnesota. About 50 species in genus found in North Temperate Zone and well-represented in South America. Seems to be most important in our area.

Flowers in heads, crowded to make a powder-puff effect at top of erect flowering stems. Plants have either flowers bearing stamens or flowers bearing pistils. Each head is about ¼ in. in diameter, with those bearing pistils appearing pink to crimson and those bearing stamens appearing white. Fruiting heads appear gray.

Flowering time April through June. Fruits found in varying amounts through latter part of year. Apparently plants of this genus are not eaten by grazing animals when other more desirable plants are available. Therefore overgrazing removes competitors and allows antennarias to take over extensive territory.

Where this plant becomes established as a weed in pastures, plowing, discing, and cultivating are usual control measures. However, these squat plants may serve a useful function as soil anchors where soil is thin and might be washed away were no other cover provided. Some relatives may form indigestible cud balls in cattle.

Pearly Everlasting
Anaphalis margaritacea

Height to 3 ft. Stem branched in upper areas, densely covered with a white, woolly substance, and well-supplied with leaves. Leaves to 5 in. long and to ¾ in. wide, woolly beneath and somewhat downy above, green, with margins frequently turned inward and lower leaves the shorter.

Native of North America. Found on dry soil from Newfoundland to North Carolina, west to Oregon and Alaska. Established in Europe and northern Asia. Of the 3 dozen species, most are native of North Temperate Zone. This one is sufficiently attractive to be listed as a wild flower.

Flowers in numerous heads grouped into a compact flat-topped cluster that may be 8 in. across. Individual heads may be ¾ in. across with bracts of enclosing involucre; with outer apparently shortest and pearl white. Tubular pistillate, and slender staminate flowers are usually in same head.

Flowering time from July through September. Sometimes grown as ornament in wild-flower gardens. Of related species known as cudweeds, a number are listed as weeds but few if any are serious pests. Most can be controlled either by drainage or by cultivation of the land.

The name everlasting is applied to a number of species of this genus and of other genera, for example, *Helichrysum*, the strawflower, which appears commonly in bouquets sold at roadside stands in the West (see p. 340).

Low Cudweed
Gnaphalium uliginosum

Height to 8 in. Stems sprawling on ground or turning upward at tip, or erect, well-branched close to ground, covered with relatively closely pressed white wool. Leaves to 2 in. long, narrow, well-covered with white wool, pointed. Root system shallow or with deep penetrating taproot. Annual.

Native of North America and of Europe. Found usually in damp soils from Newfoundland to Virginia, west to Oregon and British Columbia. Well over 100 species of the genus covering a wide geographic area. Sometimes, owing to various conditions, they may apparently crowd out all other plants.

Flowers grouped in relatively small heads at end of erect stems and often partially enclosed in leaves. Flowers all tubular, with outer flowers with pistils and no stamens, and larger, relatively few inner flowers with both pistils and stamens. Enclosing bracts whitish.

Flowering period July through to October. Fruits found from midsummer to end of year. Favors wet lowlands, the sides of streams, and waste places and must have water to be at its best. Consequently it is often easily controlled by drainage practices.

Sometimes plant is grown in borders in wild-flower gardens and even in other gardens. Hoeing will keep it within bounds in such situations. Where it seems to have crowded out other plants, it may be merely surviving where others could not stand existing conditions.



Elecampane



Rosin Weed



Common Ragweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Elecampane
Taraxacum officinale

Height to 6 ft. Stem coarse, branched or unbranched, usually rising from a large rootstock, densely downy to hairy in upper parts. Leaves to 20 in. long and to 8 in. wide, downy, rough above; the larger lower ones with long petioles the upper with none but with clasping bases.

Introduced from Europe and well-established in America. Also native of Asia. Found in dry fields and meadows from Nova Scotia to North Carolina, west to Missouri and Minnesota. Of nearly 100 species of the genus to be found in Europe and Asia, this is only one that seems to have become established in America.

Flowers borne in large heads at or near tips of uppermost branches. Heads to 4 in. across and to 1 in. high, with outer ray flowers pistillate and tubular center flowers with both stamens and pistils. Rays, numerous. Bracts of enclosing involucre almost leaf-like. Fruit a dry, smooth, 4-sided, 1-seeded achene.

Flowering time from July through September, with fruits being borne from August through October. Fruits usually insect-infested. Cultivated best in deep clay soil. Usually propagated by divisions of old roots planted in fall. Set 18 in. apart, in rows 3 ft. apart, or may flower from seed second year. Second-year roots dug in fall, dried, and sliced.

1 acre may yield to 1 ton of roots, worth 6 cents per lb. wholesale, with nation's consumption about 50,000 lb. a year. Roots used as a drug; or fresh roots are candied in sugar and used as a medicinal confection. Leaves reported to be edible but this is questioned seriously.

Rosinweed, Compass Plant
Silphium laciniatum

Height to 12 ft. Stems branched or unbranched, distinctly resinous, rough and harsh, stiff, arising from a thick deeply penetrating root. Leaves alternate, long-petioled, to over 1 ft. long, deeply cut, the upper with clasping bases; sometimes almost entire.

Native of North America. Found on open prairie country and along dry roadsides from Ohio to Alabama, west to Texas and the Dakotas. A dozen species of the genus to be found in North America. Indian cup, *S. perfoliatum*, is a wet-soil species but most are at their best in dry lands.

Flowers in several heads at ends of branches. Heads to 5 in. across, with individual ray flowers to 2 in. long and from 20-30 in number. Rays notched at tip, yellow, pistillate and produce fruits. Yellow disc flowers tubular, with stamens and pistils but do not produce fertile seeds.

Flowering time July through September, fruiting time August through October. Perennial. Propagation commonly by seeds. Leaves frequently arrange themselves in a plane that indicates north and south but this is not wholly reliable.

Plant is a relatively common weed but it yields to cultivation. It has been reported that the Omaha Indians used the tarry juices that come from scarred areas and some persons break the plants to induce flow of this substance.

Common Ragweed
Ambrosia artemisiifolia

Height to 6 ft. but usually much less. Stem profusely branched, downy, smooth, or intermediate. Leaves thin, the upper alternate, the lower opposite for most part, twice-divided into a lace-like arrangement, to 4 in. long, deep green above and paler beneath. Root system deeply penetrating. Annual.

Native of North America. Found as a pernicious weed from Nova Scotia to Florida, west to Mexico and British Columbia, though Canadian line marks almost the northern limit of serious abundance. Of the 15 species of the genus, most are natives of North America, where some are serious weeds.

Flowers borne in 2 kinds of clusters. Conspicuous staminate flowers borne in terminal clusters that are to 6 in. long, with head drooping, with both heads and clusters numerous. Pistillate flowers in axils of upper leaves, concealed, the one flower producing a top-shaped fruit with a pointed crown, about $\frac{1}{8}$ in. long.

Flowering time July through October. Fruits maintain a ready fertility for 5 years or more so fruit production should be stopped. Some plants yield only pistillate flowers. This plant harbors a borer in the stalk with a wasp-like parasite that destroys Oriental fruit moth, a serious peach-orchard pest.

While the plant is one of major sources of pollen that causes hay fever, nevertheless fruits form a major winter food for grouse, quail, and wild turkeys and an oil has been extracted from the fruits that has unique drying qualities and some food value. Related *A. psilostachya* is more western in its range and is perennial.



Giant
Ragweed



Cockle Bur



False
Sunflower

PHYLUM SPERMATOPHYTES. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Giant Ragweed
Ambrosia trifida

Height to 18 ft. Stem coarse, erect, branched, rough, scaly, smooth or with fine stiff hairs. Leaves opposite, petioled, of 3-5 lobes, coarse, dark-green; the lower ones to over 1 ft. wide and the upper smaller and sometimes not lobed; veins joined inside leaf margin. Annual.

Native of North America. Found usually in rich moist lowlands while common ragweed is at best in drier uplands. Ranges from Quebec to Florida, west to New Mexico, Colorado, and Manitoba. One of more conspicuous wasteland, lowland plants of Middle West.

Flowers staminate, in terminal or axillary clusters to 10 in. long, with the heads small and clustered along main axis; pistillate, clustered in axils of upper leaves and yield top-shaped fruits to $\frac{1}{8}$ in. long and crowned with 1 large and a number of small tubercles.

Flowering time July through October, at which time amount of pollen freed from a patch must be enormous. It, like the pollen of the common ragweed, causes hay fever. Since plant grows in lands that normally are not cultivated, it usually continues contaminating an area without interference.

One of worst hay-fever weeds but also one whose fruits are eaten by some game birds as well as being parasitized by a number of insects. Forms escape cover for pheasants and rabbits. Known as buffalo weed, horse cane, bitterweed, richweed, and wild hemp.

Cocklebur
Xanthium orientale

Height to 2 ft. Stem rough, light green to light straw-colored, coarse, branched, angled, sometimes with red spots. Leaves alternate, simple, long-petioled, rough and downy, to 5-6 in. long, lobed or only slightly so. Root system deep. Annual.

Native of North America. Found through southern Canada to Mexico, being one of worst weeds of Mississippi Valley area. More than a dozen species in the genus, with representation over a wide geographic area. Most of them favor sandy ground where water is available at no great depth.

Flowers: staminate and pistillate in separate heads on the same plant; the staminate in short ball-like heads at ends of branches; the pistillate developing into coarse-spined burs crowned by 2 inwardly curving spurs which contain 2 fruits, flattened and generally oval in outline.

Flowering time August through October. One fruit may germinate the first year and the other the second year. Seeds and young plants contain the poisonous glucoside xanthostrumarin, which decreases as plant matures but if eaten may cause depression, vomiting, weak pulse, lowered temperature, spasms, and often death.

May be a serious pest in crops. Plants should be hoed and cultivated out of existence, controlled by modern weed sprays or by rotating crops to include clover and grass, which compete successfully and eliminate the cocklebur. If poisoning has resulted from eating the fruits, milk may be drunk to counteract it.

Oxeye, False Sunflower
Helopsis helianthoides

Height to 5 ft. Stem coarse, smooth, erect, branched, somewhat ridged. Leaves opposite or in whorls of 3, to 6 in. long and to nearly 3 in. wide, petioled, with even-sized saw-toothed margins, with blade rounded at base and pointed at tip, with relatively conspicuous veins. Perennial.

Native of North America. Found in open meadows and waste places from southeastern Canada to Florida, west to Tennessee and the Dakotas. All 6 species of the genus are native of North America. 2 commoner species in East are separated in part on smoothness, this one being smooth while *H. scabra* is rough.

Flowers in heads, to nearly 3 in. across, terminal or axillary in uppermost branches, with ray flowers that are to 1 in. long, pistillate and developing into fruits. Disc flowers tubular, with stamens and pistils. Bracts of enclosing involucre rather large, with those to outside larger than those toward center.

Flowering time July through September. Unlike sunflowers and coneflowers, ray flowers persist on top of fruit that yields a fertile seed. Easily mistaken for a sunflower. Is apparently of no medicinal or economic importance, nor is it poisonous under any circumstances.

This species is not ordinarily listed as a weed, and since it yields readily to cultivation, it cannot be considered as competitive with farmers' interests.



Cone Flower



Black-eyed Susan



Purple Cone Flower

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Campanulales. Family Compositae

Coneflower, Golden Glow *Rudbeckia laciniata*

Height to 12 ft. Stems smooth, rather slender, much-branched, stiff, somewhat ridged. Leaves finely 5-7 divided, with division in turn deeply toothed along margins. Whole leaf may be over 1 ft. wide, on relatively long petioles, rather thin, downy, at least above. Stem leaves smaller. Perennial.

Native of North America. Found often abundantly in thickets from Quebec to Florida, west to Arizona, Colorado, Idaho, and Manitoba. Variety *hortensis* is the golden glow of flower gardens. The related *R. speciosa* is a 2-ft. plant known as "showy cone-flower" and relatively common in flower gardens.

Flowers in heads at ends of branches, to 4 in. across, with 6-10 ray flowers that may be to nearly 2 in. long, drooping, bright yellow, and with central cone of disc flowers shaped like a chocolate drop, greenish-yellow and about twice as long as thick. Golden glow has "double" flowers, or more ray flowers.

Flowering time from July through September. Plant has been suspected of being poisonous to hogs, with poisoning similar to that caused by belladonna, but this has not been proved. Golden glow of the garden and cone-flower of the field are both beautiful.

Stems of garden golden glow often break when they are in full bloom, so a rigid support for each major clump should be provided. Both golden glow and cone-flower have red aphids as serious pests in great numbers. Where the flowers are to be picked, the plants should be sprayed with aphid-control liquids.

Black-eyed Susan *Rudbeckia hirta*

Height to 3 ft. Stems erect, stiff, rather brittle, simple or sparingly branched, roughened, with fine, stiff hairs, with many stems sometimes forming tufts. Leaves thick, almost entire or only obscurely notched along margins; the lower ones with long petioles, to 7 in. long and to 2 in. wide; the upper smaller.

Native of North America. Found commonly in open dry meadows and pasture lands, or in waste places where there is good sun. Found from Ontario to Florida west to Texas, Colorado, and Manitoba. Related niggerhead *R. occidentalis* provides some forage and erosion control in the western areas of the country.

Flowers in attractive heads at ends of stems or branches. Heads to 4 in. broad, with 20-40 neutral orange-yellow ray flowers to nearly 2 in. long, notched or not at tip, with compactly crowded dark-brown tubular disc flowers that produce fertile seeds. Fruit has no parachute.

Flowering time May through September. Dead tops bearing some seeds may be found through the succeeding winter. In Colorado and Wyoming, plant is reported to provide some forage for sheep and cattle but it may be merely that nothing else will survive where it does.

An attractive flower that is sometimes grown in wild-flower gardens, more often is considered as a weed by farmers, and as suggested above may be welcomed as a lunch by a starving sheep or cow. The niggerhead lacks the ray flowers so characteristic of the cone-flowers and black-eyed Susans. Maryland State flower.

Purple Coneflower *Brauneria purpurea*

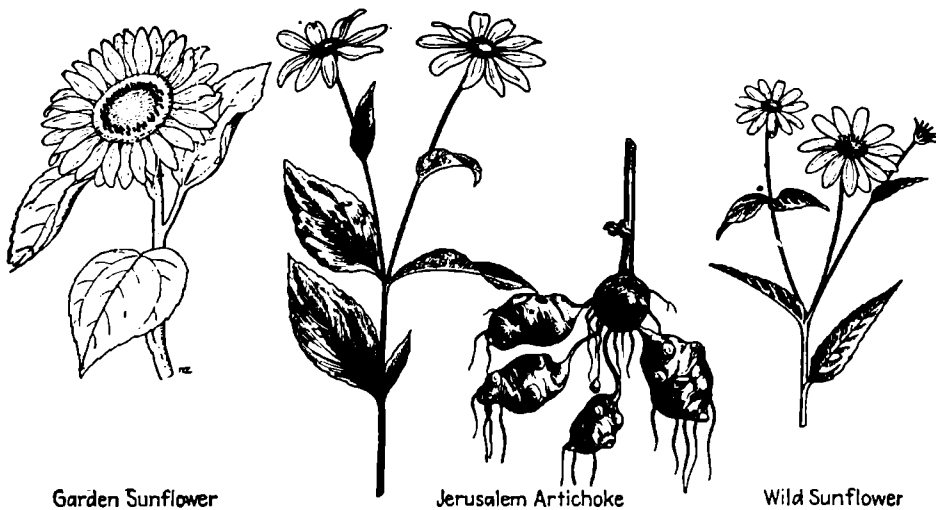
Height to 5 ft. Stem stout, simple or sparingly branched, covered with fine stiff hairs or only slightly so. Leaves of *B. purpurea*, to 8 in. long and to 3 in. wide, long-petioled, with blade with shallowly scalloped margins; of *B. angustifolia*, as shown in the figure. Perennial, with thick dark rootstocks.

Native of North America. Found in deep moist rich soils. From Pennsylvania to Georgia, west to Louisiana, Arkansas, and Michigan, with narrower leaved species extending range much farther west. Probably more than 3 dozen species of the genus native of North America.

Flowers in huge solitary heads at tips of branches, with 10-20 rays sometimes as much as 3 in. long, drooping or spreading, purple, red, crimson, or pale purple. Ray flowers neutral. Disc flowers tubular, bearing both stamens and pistils. Fruits, husky, 4-sided achenes.

Flowering time July through October. Fruiting time August through November. In some parts of the country, this plant may be a pest, but it yields rather readily to hand pulling or to cultivation. If it needs control, care should be taken to prevent formation of a new crop of seeds.

This plant is so attractive that while Middle Westerners think of it as a weed, Easterners plant it in their flower gardens and are pleased when it becomes established. Certainly it has beauty in excess of many plants considered worthy garden plants.



Garden Sunflower

Jerusalem Artichoke

Wild Sunflower

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Garden Sunflower
Helianthus annuus

Height to over 15 ft. Stem coarse, somewhat branched or unbranched, rough-scaled, somewhat hollow. Leaves alternate, at least in upper areas, petioled, with 3 conspicuous veins, with a blade to 1 ft. or more across and somewhat longer, somewhat heart-shaped at base and pointed at tip. Lower leaves may be opposite. Annual.

Native of North America or of Peru. Found wild in gardens and in rich soils. From Minnesota to Texas, west to Pacific Coast. Reported as being found north into Saskatchewan. Has occurred as an escape in widely separated parts of the world. May establish itself where it is cultivated.

Flowers in heads at ends of branches. Heads may have a diameter to 2 feet, and in wild plants to 6 in. Ray flowers yellow streamers, mostly entire, relatively few. Disc flowers brown to purple. Fruits flattened oval, usually striped with light and dark gray, widest near upper end.

Flowering time July through September. Root system of a sunflower may occupy over 1 cu. yd. and 1 acre of sunflowers may lose nearly 400,000 gal. of water through transpiration. Fruits sought by many seed-eating birds, particularly goldfinches, who may ruin a commercial crop.

Raised commercially for their fruits, which are excellent food for poultry and highly favored for bird-feeding stations. Fruits are high in oil. Plant is cultivated in Peru and in many other parts of the world for the production of sunflower oil used as food, in soap, and on leather.

Jerusalem Artichoke
Helianthus tuberosus

Height to 12 ft. Stems coarse branched in upper areas, downy or with short, stiff hairs arising from fleshy white delicious sweet thickened horizontal rootstocks that bear tubers as offshoots. Leaves opposite, rather stiff, rough above and downy beneath, petioled, to 8 in. long and to 3 in. wide. Perennial.

Native of North America. Found in loose moist soil or in good garden soil from Nova Scotia to Georgia, west to Arkansas, Kansas, and Manitoba. Occurs in cultivation in a number of areas. At least 70 species of *Helianthus* to be found in the Americas.

Flowers borne in heads at tips of uppermost branches. Heads to nearly 4 in. across, with from 10-20 yellow ray flowers that are notched at tip, well over 1 in. long, and neutral. Yellow, tubular disc flowers, perfect, bearing both stamens and pistils. Fruits, downy.

Flowering time September through October. Tubers mature at end of fall and may be collected then or in spring. Cultivated by the Indians for centuries and introduced into Europe in 1616. Has been cultivated more extensively in Europe than in its native America and is known as "Canadian potato."

Carbohydrate food in tuber is in form of inulin, which is good for diabetics, and is also a source of levulose and is used for the production of industrial alcohol. The plant is also grown as a forage crop and as a competitor of weeds. Tubers are eaten raw or cooked and in either case are delicious.

Wild Sunflower
Helianthus decapetalus

Height to 5 ft. Stem branched, slender, smooth or almost so, arising from a substantial, sometimes thickened rootstock. Leaves alternate above; opposite below, though some of those on flowering branches may be opposite; thin, to 8 in. long and to 3 in. wide, rough above and downy beneath; the lower with petioles.

Native of North America. Found from Quebec to Georgia, west to Missouri and Michigan. Many closely related species that extend range of native sunflowers to the west. In fact, Kansas is known as the Sunflower State and the sunflower is naturally its State flower.

Flowers in good-sized terminal heads, with ray flowers numbering from 8-15 and being much longer than the disc is wide. Whole head sometimes more than 3 in. across. Disc flowers tubular, yellow, and rather compactly crowded together. Fruits, smooth dry dark achenes.

Flowering time August through September. Fruits of most wild sunflowers gathered by Indians and used as food either raw, crushed, roasted, or in mixtures. Sunflower seeds roasted and salted are in many respects as good as or better than salted peanuts. Unfortunately, their shells must be removed.

Sunflower fruits when properly roasted may make a drink that has some of the qualities of inferior coffee. This species is not listed as a bad weed but others are not so free from criticism.



Zinnia



Sweet-bush



Dahlia

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Zinnia
Zinnia elegans

Stems stiff, erect, hairy, and to 3 ft. high. Leaves opposite, compound, lobed, more or less clasping at bases, with roughened surfaces which are somewhat sticky and which show prominent veins. Roots fibrous, relatively strong.

Single form, native of Mexico; double form, of French origin, where it first appeared in a garden in 1856. Introduced through United States and other temperate parts of world. Best in rich, well-drained, loose loam and favors sunny areas.

Flowers in solitary, terminal heads, from 2-4½ in. across. Ranges from crimson to scarlet, salmon, rose, purple, orange, yellow, and white. *Z. haageana* has orange flowers. *Z. multiflora* has slender linear red or purple rays. Pollination mostly by moths and butterflies.

Annual. Propagated from seeds which germinate in about 5 days and live to 4 years. Seeds sown indoors in March, transplanted after frosts cease, thinned in rows to 12 in. apart. Cultivate lightly; water thoroughly in dry weather. Prune smaller heads to produce larger remaining heads. Enemies include leaf rollers controlled by lead arsenate spray, tarnished plant bug controlled with nicotine sulfate spray, cut worms controlled with poison baits, and European corn borers controlled by burning infected plants. Hummingbirds visit flowers.

Good in beds and borders, dwarf *Z. haageana* being better for edgings. Flower heads should be removed before seeds are formed if blooming is to be continued. Flowers attractive; keep well after being cut, some lasting many days. Some are almost shrubby. Indiana's State flower.

Sweetbush
Bebbia juncea

Height to about 5 ft. Stems woody, branching freely to form an almost globular head, to 5 ft. in diameter but in the dry season looking practically dead, whitish, thus adding to dead appearance. Root system deeply penetrating. Leaves alternate, entire, absent for much of year. Perennial.

Native of deserts of southwestern areas. Found in Mohave and Colorado deserts, being most abundant and best developed on broad sandy washes of Colorado desert. Genus does not have any common representatives to the east but is closely related to *Coreopsis*.

Flowers in yellow fragrant heads. Appear in great numbers whenever rains furnish enough water to roots to start development and may practically hide stems, which are leafless at the time or practically so. In full bloom, plant is one of most attractive desert plants.

Bebbia or sweetbush is a good honey plant. When in bloom, is visited by great numbers of bees. Sweet flowers are eaten by a number of animals. Lizards known as "chuckwallas" feed upon them greedily. Apparently, it offers no particular indication of ecological condition of its surroundings.

An attractive flower of the desert that may intrigue the tourist. Apparently it is of no great significance to man aside from its beauty, fragrance, and indirect contribution to honey production.

Dahlia
Dahlia pinnata

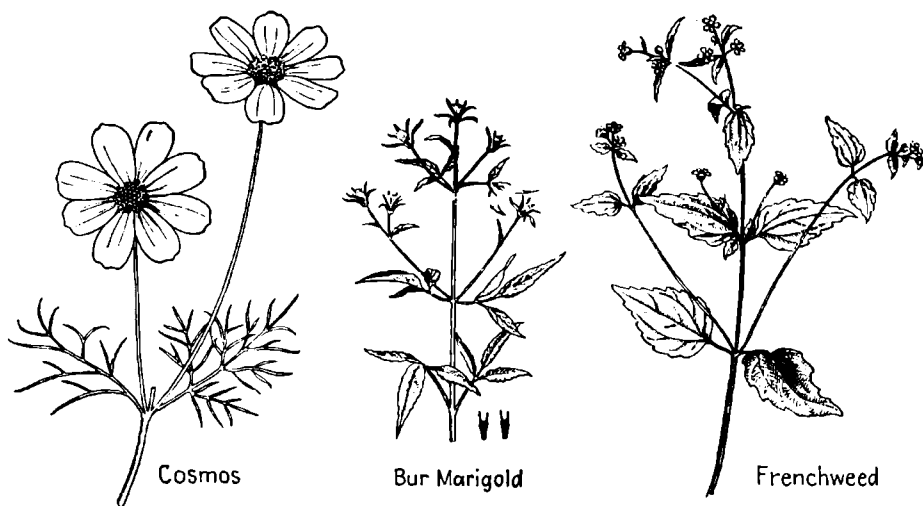
Height to 4 ft. Stems smooth, considerably branched. Leaves green above, grayish beneath, with upper divided, and in turn divided again, opposite or whorled, with bases of petioles almost grown together. Some related dahlias are woody and perennial while others are annual.

Native of Mexico and extensively developed in United States and elsewhere, mostly as spectacular ornamentals for their huge blooms. Roughly, 2 major groups of dahlias, the tree and the bush dahlias, of which the latter are most commonly seen in gardens.

Flowers of *D. pinnata*, in heads to 8 in. across or sometimes much over this, nodding or horizontal. So-called "single dahlias" have a single row of ray flowers and have yellow centers. Semidouble forms are called "duplex dahlias," while peony dahlias resemble peonies (see cut).

Seeds of some dahlias sown in spring may yield flowers in fall; but usually propagation is by division of roots. Need sandy soil where nights are cool, where there is little nitrogen as fertilizer, since this stimulates leaves rather than blooms. Roots planted 2-3 ft. apart, to 4 in. deep, and shoots cut back to one.

Dahlias are good as cut flowers if they are dipped in hot water that is allowed to cool before flower is put in its place. Roots should be dug in fall before frost danger; stems should be cut off and roots stored where cool and not too dry or too wet.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Cosmos

Cosmos bipinnatus

Stems to 6 ft. high, smooth or nearly so and relatively slender. Leaves opposite, compound, or lobed and cut into slender parts so that they look lace-like, but this is not the case with all species. Roots fibrous and relatively strong. Plant as a whole most attractive.

Native of Mexico. Only earlier flowering forms hardy enough to bloom well in northern United States. Best in well-drained sandy loam which is not too rich and which is exposed to full sunlight for relatively long periods. If soil is too rich, plants fail to bloom.

Flower heads solitary or in loose clusters on long stems; single or double; about 3 in. wide, with ray flowers pink, red, or white and central disc yellow. In *C. sulphureus*, rays are yellow; in *C. diversifolius*, disc is red. Floral bracts oval and unequal.

Annual. Propagated from seeds which germinate in about 5 days and live about 3 years. Early varieties sown in April are transplanted when weather permits, thinned to 18 in. apart, cultivated until blooming begins in September. Blooming continues until frost. In South, plant selfsows. Spotted cucumber beetles bad cosmos pests, controlled by spraying with arsenate of lead. European corn borer and a stem blight also attack the plant. Injured plants should be burned to prevent spread of trouble. Since plant may break, it should be staked.

Excellent plant to use in masses and supply attractive cut flowers which do not wilt readily and may last several days. Form may be controlled by pinching off parts not wanted to fill desired space.

Bur Marigold

Bidens frondosa

Height to 5 ft. Stem erect, purplish, stiff, branched, smooth or nearly so. Leaves opposite, usually smooth, thin, to 4 in. long and 1 in. wide, the lower divided into 3-5 segments, with end one particularly long-pointed, long-petioled with a groove on upper side of petiole. Annual.

Native of North America where it is found in gardens, meadows, pastures, and roadsides where it is wet. From Nova Scotia to Florida, west to California and British Columbia. Introduced and has become established in southern Europe. 75 widely distributed species in the genus.

Flowers in numerous heads, at tips of upper branches, each head to $\frac{1}{2}$ in. long and to nearly 1 in. wide. Ray flowers may be absent or inconspicuous. Disc flowers orange, and produce flat black 2-awned fruits. Bracts of the enclosing involucre usually rather leaf-like.

Flowering time July through September. Fruiting time August through to December. Since the plant requires abundant moisture, drainage provides an effective control measure if repeated cutting is not sufficient. Plants should be cut to prevent reseeding. Fruits spread by sticking to animals.

Mechanical injury may be caused to sheep and other animals by the stiff-awned fruits that may make their way to the skin and cause serious irritation. In Africa, the natives make leaves into a sort of greens, but this does not sound appealing to those who have smelled the plant.

French Weed

Galinsoga ciliata

Height to 3 ft. Stem erect or more commonly sprawling, slightly downy or hairy, branched, pale green, slender, weak. Leaves opposite, to 3 in. long and well over half as broad, 3-nerved, petioled particularly in the lower leaves, with the margins scallop-toothed. Upper leaves sometimes without petioles. Annual.

Native of tropical America but established from Maine to Florida, west to California, Mexico, and Oregon. Has been introduced into and has become established as weed in Europe. Of 5 species in the genus, all are native of tropical and subtropical America. Usually, this is the species found in North.

Flowers in heads, borne on stems singly, in axils of upper leaves, to $\frac{1}{4}$ in. across but commonly smaller. Ray flowers white, with 3 teeth at free end, pistillate, and producers of fertile fruits. Disc flowers yellow; produce fertile fruits; bear both stamens and pistils. Fruits, dark.

Flowering time August through October. Fruiting time September to December. Northern range determined largely by length of period between killing frosts. Since it is an annual, control measures might well center around prevention of formation of mature fruits.

A harmless weed of waste places such as along paths and at edges of buildings. When it comes into competition with any cultivated plant, it retires with good grace at first sign of a hoe or cultivator. Were its flowers larger, they would be considered as ornamental. Edible as greens.



French Marigold



Sneezeweed



Pot Marigold

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

French Marigold
Tagetes patula

Bushy annual. With stems to 1½ ft. high, compact, relatively stout. Leaves dark green, compound, and divided into about 12 long-toothed segments. Glands on leaves give off a distinctive odor. Leaves of *T. lucida* not compound. Roots fibrous and relatively pruruse.

Native of Mexico, but greatly modified by cultivation. Grown widely in United States and Canada. About 20 species ranging from New Mexico and Arizona to Argentina. This species prefers sunny area where there is light loam and moderate amount of moisture.

Flowers in heads, single or double, yellow or orange and marked with brown or maroon. Heads about 1½ in. across. In *T. lucida*, heads are clustered; in others, solitary. In *T. signata*, heads are about 1 in. across, not red marked, and ray flowers are few. In *T. erecta*, heads are 2-4 in. across.

Propagate from seeds which germinate in 5 days and live to 4 years. Seedlings transplant well and thrive better if transplanted frequently. Should be thinned to 15-18 in. apart and cultivation should be light but frequent. Will blossom from June to frost under proper treatment and may self-seed. Enemies include yellow woolly caterpillars controlled by hand picking, leaf tiers controlled by lead arsenate spray, arnished plant bugs controlled by nicotine sulfate spray. In greenhouse cultivation, requirements are light soil, good ventilation and temperature of 55°F. Needs room.

Desirable plant for border edges or in mass plantings. Also popular with commercial florists as commercial early flower for spring sales. Flowers arrange themselves and keep well when cut. For commercial sales, seeds are sown in January; seedlings are sold in pots of 3-4 in shallow containers.

Sneezeweed
Helenium autumnale

Height to 6 ft. Stem angled or winged, branching in upper areas, pale green, slender, smooth or only slightly downy. Leaves alternate, coarsely toothed, firm, to 5 in. long and to 2 in. wide, with blade pointed at each end and petioles forming narrow wings that extend down stem. Perennial.

Native of North America. Found in wet areas such as swamps and low meadowlands or in flooded regions, often in gravel. From Quebec to Florida, west to Arizona, Nevada, Oregon, and Manitoba, reaching the 2,600-ft. elevation in Virginia. Of 24 species in genus, all are native of North and Central America.

Flowers in conspicuous terminal heads to 2 in. or more across, with 10-20 drooping yellow ray flowers to over 1 in. long, with 3 well-defined teeth at the free end, pistillate, and productive of fertile fruits. Disc flowers darker, yellow, when completely matured, formed into a spherical head.

Flowering time August through October. Fruiting time September through November. A bitter substance is found all through plant, but particularly in mature flower heads, which if eaten creates a strong appetite for more. Powdered flower heads are used medicinally for the purpose of stimulating sneezing.

Cattle, sheep, and horses with an appetite for the plant may have accelerated pulse, difficult breathing, staggering gait, sensitiveness to touch, spasms, and convulsions that may end in death. Control of the plant as a weed is by cutting, cultivation, and drainage of the site.

Pot Marigold
Calendula officinalis

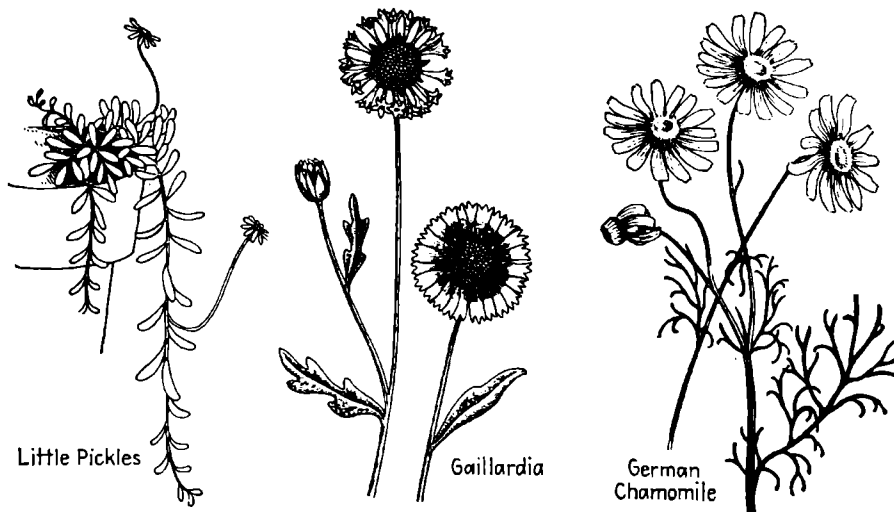
Height to over 2 ft. Stem relatively stout, straight, somewhat hairy. Leaves alternate, simple, to 4-5 in. long and about half that wide, with bases that are more or less clasping, entire, or only very obscurely toothed with leaves or bracts of flowering branches smaller than lower ones. Annual.

Native of southern Europe but grown as an ornamental in many parts of the world. Flower culturists have improved size, color, and form of flowers. About 15 species known in the genus native either of Europe or of territory not far from it. Does well either in open or in greenhouses, under cultivation.

Flowers borne in relatively large heads at ends of branches. In old varieties, flower heads were single, but now they are double for most part. Typical heads are to 2 in. across, with the flat rays varying from pale yellow to deep orange and closing the head at night.

Seeds may be planted in open ground or cold frame and in good soil and sun. Flowers should develop by early fall; plants should self-seed but in this case fancy varieties will revert to original single type. These are the "winking Mary-buds" of Shakespeare's "Cymbeline." Summer-sown plants are potted for winter.

Leaves and heads used as potherbs. Has been considered a remedy for sore teeth and as a "comforter of the heart and spirits," also used as an emetic and in the treatment of warts. Varieties include the brilliant orange Campfire, the rich yellow Chrysanth or Sunshine, the orange Fantasy, the quilled Radio, and others.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Little Pickles
Othonna crassifolia

Stem slender, trailing, rooting freely at joints; therefore, difficult to measure; smooth, sometimes shrubby at base, often drooping or, if potted, hanging over edge. Leaves usually under 1 in. long, shaped like smooth pickle, thick and with pointed free end, woolly at base. Roots fibrous. Perennial.

Native of South Africa where there are some 80 native species. A common greenhouse plant. Does well in ordinary sunroom of a home where it is likely to get comparatively little care. Rather closely related to *Calendula*.

Flowers in yellow, daisy-like heads that are about $\frac{1}{2}$ in. across borne on slender, to 6-in. erect or ascending stems; usually open only when exposed to direct sunlight. Ray flowers flat and fertile. Disc flowers tubular and sterile. Flowers not too conspicuous.

Flowering time may be at almost any season under greenhouse conditions. Ideal conditions call for planting parts of stem in dark, sandy soil. When fully rooted, plants are set in pots in sunny window and kept at temperatures preferably between 60–70°F. Ordinarily, plants flower less in winter than in summer.

Our only use apparently is as a curious greenhouse ornamental. It is easy to propagate and to care for and therefore rather popular. When stems get too long, they are merely cut back and new ones develop while cut stems may be used to start new plants.

Gaillardia
Gaillardia aristata

Erect stems to height of 3 ft., more or less short-haired, relatively slender and stiff. Leaves alternate, gray-green, longer than wide, entire or cleft; lower ones paddle-shaped; in some species leaves almost entirely basal. Roots stout and fibrous.

Native of United States, from Minnesota and Manitoba, west and southwest, but now spreading east. 12 related American species, mostly from Far West. Grows well in sandy soil with good drainage. Favors strong sunlight. Can endure partial shade and resists cold.

Flowers in terminal heads 2–4 in. across; daisy-like, yellow or yellow-orange. Related annuals *G. amblyodon* and *G. pulchella* have flowers normally red; lobes of disc flowers of former being obtuse while those of latter are acute. Pollination by insects.

Propagated by seeds, division, or by stem or root cuttings. May bloom first year from seed but is better second. Seeds germinate in 20 days, live about 2 years; should be sown early. Named varieties should be grown from cuttings to assure desired characters. There are some annual forms. Not often seriously injured either by insects or by fungi. Hardy in severe weather. If flowers are kept picked, blooming will continue from June to November, long after many other common species have ceased. Typical plant of western plains.

Vivid, sprawling, hardy plants that deserve popularity they enjoy. Flowers cut before they are open last longer than those cut when mature. In gardens, perennials are favored because they do not need to be purchased or planted new each year.

German Chamomile
Matricaria chamomilla

Height to 2 ft. Stem erect, smooth, much-branched. Leaves 2–3 times cut, like parts of a feather, with short narrow segments, light or dark green; generally appear like loose fragile lace, making whole plant highly ornamental. Leaves to 1 in. broad. Annual.

Native of Europe but established as escape in New York and Pennsylvania. Cultivated as an herb plant for its drug in many parts of world. Only about 4 of the 20 species of genus have been established in eastern North America; others are Eurasian and African. Cultivated mostly in Germany and Hungary.

Flowers in daisy-like heads, with 10–20 rather slender and spreading white ray flowers; central disc flowers arranged in a cone-like manner. When flowers are broken from receptacle, they leave no remaining scales. Fruits without downy parachutes, faintly 3–5-ribbed.

Flowering time June through August or September. Seeds sown in spring yield flowers in 8 weeks, so crop may be grown between others. Flowers collected in full bloom yield a strong unique aromatic odor and a bitter taste. Extracted oil is thick deep blue, then brown, and known as "matricaria" or "anethmic acid."

Matricaria oil extracted by boiling is used to reduce gas in stomach, as a stimulant or tonic, to soothe children who are teething, or for earache or other localized pains. Relatively harmless as a home remedy. Used as a hair rinse to add luster to the hair. 1 acre can yield 400 lb. of dried flowers worth about 20 cents per pound.



Chamomile



Yarrow



Oxeye Daisy

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE

Order Campanulales. Family Compositae

Chamomile, Mayweed

Anthemis cotula

Stem to 2 ft. high, well-branched to form a sprawling or spherical mass, smooth or downy, with a bitter taste and a strong unpleasant odor. Leaves to 2 in. long and to 1 in. wide, finely twice-divided to form a lace-like effect, weak, abundant, alternate, with upper leaves commonly smaller than lower. Annual.

Native of Europe. Firmly established in America. An ever-present weed of barnyard, roadside, and wastelands. It finds a home in America, Asia, Africa, or Australia and establishes itself firmly. It lives on a variety of soils, with a great variety of plant associates.

Flowers in heads, something like small daisies, about 1 in. across, with 10-20 ray flowers, white, and usually with 3 teeth at free end, with or without pistils, usually bent somewhat backward. Disc flowers tubular, yellow, and producers of fertile fruits. Fruits somewhat cylindrical, dark, with long rows of tubercles.

Flowering time June through October. Fruiting time from July through to December. May be controlled as a weed by heavy cultivation and spring harrowing. Capable of causing a burning sensation to wet skin. Cattle that eat it may give badly flavored milk. May be a pernicious weed in gardens.

Related field or corn chamomile *A. arvensis*, with straw-colored fruits and without ill-scented juices, and yellow-flowered yellow chamomile *A. tinctoria* are controlled in much same way as is this species. Fruits of all 3 are relatively common seed impurities in commercial seeds. Roman chamomile *A. nobilis* raised as a drug plant.

Yarrow

Achillea millefolium

Height to 2 ft. Stems usually unbranched except at top, stiff, erect, rather slender, smooth or with webby hairs. Leaves alternate, lower reaching a length of to 10 in., deep green, strongly scented, twice-divided and finely toothed to give a lace-like appearance. Root system horizontal, substantial. Perennial.

Native of North America. Some persons contend it was naturalized from Europe and Asia where it is also found. Of the more than 75 species recognized, most are native of the Old World.

Flowers borne in relatively small heads arranged in flat-topped clusters. Individual heads to $\frac{1}{2}$ in. across and more or less downy. Ray flowers number from 4-6 per head, are white or pink and, like the yellow disc flowers produce fertile fruits that are pale gray or straw-colored thin oblong wafers, easily wind-blown.

Flowering time June through November. Fruiting time August to end of year. Plant does well either in severely hot or cold climates. Achilles is purported to have used the plant to heal the wounds of soldiers in the siege of Troy. It still has some slight medicinal uses. Cattle eating it may yield bad-flavored milk.

As a drug, it has a small demand, bringing about 5 cents per pound for the dried leaves and flowers if there is a market. Leaves have been used in a tea but it is too bitter to be recommended. Where the plant is a weed, cattle have usually avoided eating it because of its taste. Cultivation keeps it in easy control.

Oxeye Daisy

Chrysanthemum leucanthemum

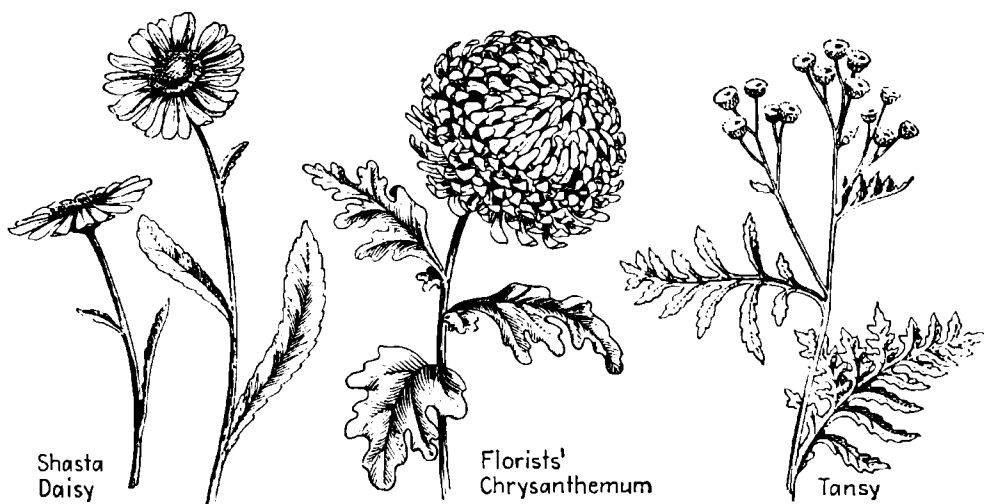
Height to 3 ft. Stem erect, green, somewhat ridged, tufted, slender, nearly smooth, usually unbranched, arising from a short thick horizontal perennial rootstock. Leaves to 3 in. long, dark lustrous green, lower ones with relatively long petioles, rather conspicuously toothed along margins. Perennial.

Native of Europe but too well established in America on pastures, meadows, and waste places through almost all of North America though less abundant in South and West. It is also native of Asia and is widely established in other continents. About 100 species in the genus, with few in America.

Flowers borne in heads at ends of branches, heads being to 2 in. across. Ray flowers number 20-30 and are flat, white, and often with 2-3 teeth in the end. Disc flowers small, yellow and densely crowded into an almost flat disc, sometimes depressed in the center.

Flowering time May through November. Fruiting time June through to December. Control possible largely by cultivation and by cutting tops before seeds have time to mature. Unfortunately, seeds may be distributed in stable manure. Salting plants helps control them but is a slow process.

Young leaves are eaten as a raw salad but if too old they are strong and unpleasant. Leaves may also be cooked as a potherb. Salting rosettes stimulates cattle to eat the plants as well as helping kill plants by direct action. State flower of North Carolina.



PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Shasta Daisy
Chrysanthemum maximum

Height to 30 in. Stems grow in clumps, branched somewhat but more commonly unbranched, somewhat downy but becoming smooth. Leaves to 1 ft. long, lower ones petioled, upper without petioles, usually under 1 in. broad. Leaves dark-green and clean looking. Short-lived perennial.

Native of Pyrenees in southwestern Europe but grown as relatively hardy garden plants or as greenhouse plants wherever ornamentals are grown in reasonably temperate climates. Related Marguerite daisy *C. frutescens* has leaves cut almost to midrib while those of this species are not so deeply cut.

Flowers in heads at ends of branches, to 3 in. or more across, with narrow blunt rays white, usually about 1 in. long; in cultivated varieties with heads to 4 in. across they may be 1½ in. long. In some forms, rays are held out stiffly while in others they droop or are even somewhat incurved.

Flowering time through most of summer months and in some forms on into fall. True Shasta daisy is an early-flowering form and in North it may be reasonably hardy if given some winter protection with a good mulch. Requires a sunny location, deep rich well-drained soil, and 1 ft. of space between plants.

Raised primarily as ornamentals. Single forms may be raised easily by seed but double forms are propagated largely by division of perennial underground part. Plants make effective mass plantings for a relatively long period of time and require a minimum of care and attention.

Florists' Chrysanthemum
Chrysanthemum morifolium

Stems erect, to 4 ft. high, in hardy varieties much-branched, ridged or fluted, generally heavily downy, with a strong odor. Leaves to 6 in. long, usually with 2 prominent lobes, relatively short-petioled, with wrinkled margins and variety of marginal smaller lobings. Perennial, but grown as annual in greenhouse management.

Common "mum" of the greenhouse is probably a hybrid of *Chrysanthemum morifolium* and *C. indicum* from China and from Japan, though very recently Korean mum *C. coreanum* has won considerable popularity. Hardy outdoor chrysanthemums with small heads may have ancestry very similar to the large greenhouse varieties.

Flowers in great heads of considerable variety including single forms, pompon forms, Japanese forms with ray flowers doubled and either curved inward, outward, or backward; hairy forms that look feather-like; anemone forms that are more nearly like single forms; and also cushion mums that make a mound to 1 ft. high, sometimes called azalea-mums.

Heads may be composed of modified ray flowers or of modified tubular disc flowers, the latter producing an anemone type of head. Chrysanthemums have been under cultivation for over 2,000 years. Best soil is a fibrous loam with well-rotted manure. Lime should be avoided. Cuttings with 2-3 joints are used. Rooted in March, should flower in fall.

Ideal conditions call for night temperatures below 50°F., with care taken to syringe flowers a number of times a day to keep down red mites and to reduce demands on roots. Costs of raising chrysanthemums in greenhouses is about 15 cents, or an 11-oz. bunch of pompons from about 3 plants should cost about 50 cents to raise and harvest.

Tansy
Tanacetum vulgare

Height to 3 ft. Stem unbranched up to the flowering portion, then rather profusely branched, smooth or somewhat downy, stiff, rather stout, strongly scented. Leaves to 1 ft. long, deep dark green, smooth, alternate, feather-like, with divisions similarly divided, petioled, with upper leaves smaller than lower. Perennial.

Native of Europe. Well-established in North America as an escape or otherwise from Nova Scotia to Georgia, west to Nevada and Oregon. Particularly common in the East around abandoned homestead sites. Of the 30 species in the genus, 2 are established in eastern United States, in California; the rest are Eurasian for most part.

Flowers borne in many heads at ends of fine branches at top of plant arranged to form a flat-topped, rather compact mass. Individual heads to ½ in. across, yellow with most flowers tubular, though there may be a few ribbon-shaped marginal flowers in the heads. Ray flowers without stamens. Fruit a 5-angled achene.

Flowering time July through September. Fruiting time August through October. Leaves and stems contain the oil tanacetin, which is poisonous to man and to domestic animals. Raised commercially for a small market, the plants being cut in late summer when in full flower. Propagation by seeds or by division, with sets 18 in. apart.

1 acre may yield to 1 ton of dry leaves. Tops worth to 20 cents per lb. Oil sells for around \$2 per lb. Michigan has distilled around 1 ton of oil a year with average oil yield per acre about 20 lb. Has been used in tea. Poisoning causes convulsions, violent spasms, dilated pupils, weak pulse, and frothing.



Common
Sagebrush



Wormwood



Coltsfoot

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Common Sagebrush

Artemisia tridentata

Height to 10 ft. Stem branching freely, shrubby, with silvery-gray hairs in abundance, tough and arising from a deeply penetrating rough root system. Leaves to 1 in. long and $\frac{1}{2}$ in. wide, narrow, wedge-shaped but with 3-5 blunt teeth, broadest near free end. Whole plant more or less fragrant when broken.

Native of North America. Found on dry plains from Nebraska to Colorado, Utah, and Montana, west to California and British Columbia. Commonest in high northern desert and sagebrush areas where it is sometimes found in almost pure stands. Some 225 species in the genus in North America, South America, and Eurasia.

Flowers borne in heads, in crowded clusters in axils of leaves, and at ends of stems with terminal clusters often many times divided. Each head only about $\frac{1}{4}$ in. through, with all flowers bearing stamens and pistils and all alike. Ripe heads fall free and are blown by winds for long distances.

Flowering time July to September. Fruiting time August to December. Survives drought by shedding most of its leaves. Its presence indicates light-textured soil, low runoff, and no salt for first foot of soil at least. Purple, sponge-like galls in summer are made by gall midge *Diarthronomyia*.

Foliage eaten by sheep and goats; and provides principal food of sage grouse; rich in proteins and fats. Tea made from bitter leaves is used in treatment of colds, sore eyes, and as a hair tonic. Ripe fruits were ground for meal by Cahuilla Indians. Wood excellent for a quick hot fire. Nevada's State flower.

Wormwood

Artemisia absinthium

Height to 4 ft. Stem branched, finely downy, rather tough and reasonably slender at least in upper areas. Leaves to 5 in. long, covered with fine white silky hairs when young turning to soft gray-green when mature, thrice-divided, with segments finely divided and lower leaves petioled.

Native of Europe and escaped in America where it was grown in gardens. Now established in many waste places from Newfoundland to North Carolina, west to North Dakota and Montana. Principal centers for cultivation in this country are Wisconsin and Michigan. Related of course to the common sagebrush.

Flowers borne in loose open clusters to 1 ft. in length while individual heads are less than $\frac{1}{4}$ in. through, drooping, not usually crowded, yellow, numerous. Central flowers of a head have both stamens and pistils. Marginal flowers have pistils only, or stamens and pistils.

Flowering time July-October. Fruiting time August through November. Plants do best under cultivation in deep moist soil, seeds being broadcast in fall after a grain harvest or started in seedbeds or from cuttings, set 18 in. apart in rows to 3 ft. apart. Planting may yield crops to 3 years.

Oil used in manufacture of absinthe, for which there is little demand. 1 acre may yield 2,000 lb. of dry plants or 40 lb. of oil but a more normal yield is 20 lb. of oil. Oil distilled by steam. Little profit in raising plant. Milk of cattle eating plant may be badly tainted.

Coltsfoot

Tussilago farfara

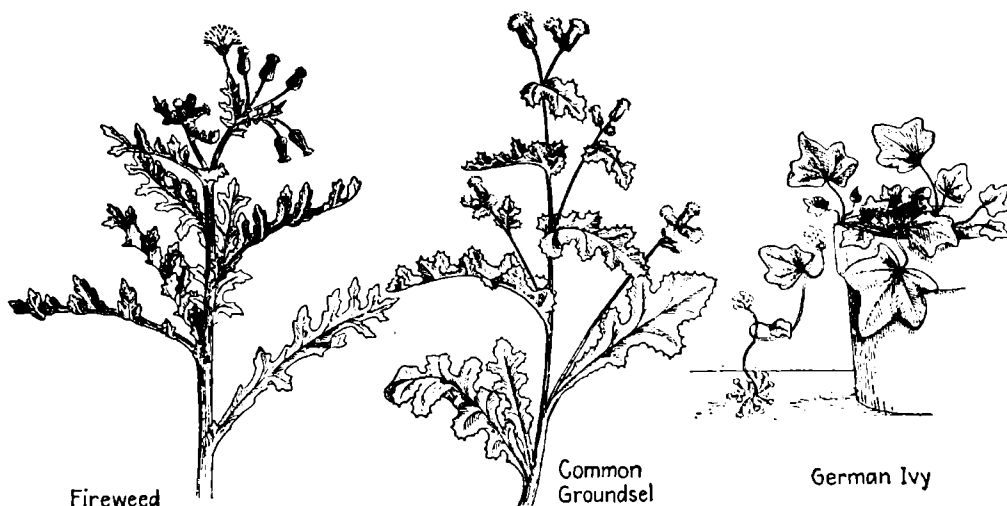
Height to $1\frac{1}{2}$ ft. Stem appears only at flowering time and bears relatively closely pressed leaf-like structures (phylloдия) that are slightly more crowded at top. Leaves arise from thick, rather juicy, branched and spreading more or less horizontal rootstocks. Leaves to 7 in. across, long-petioled, densely hairy beneath.

Native of Europe. Well-established in North America, being particularly common on dry banks such as railroad embankments. Ranges from Nova Scotia to Pennsylvania, west to Minnesota. Only one recognized species in the genus and it is native of both Europe and Asia.

Flowers appear in early spring before leaves and have usually freed their fruits by time true leaves have reached any considerable development. Flowers borne in single terminal heads about 1 in. across and vaguely resembling a dandelion head. Ray flowers fertile. Disc flowers sterile even though ray flowers lack stamens possessed by disc flowers.

Flowering time April-June. Fruiting time May-July. Fruits beautiful objects when viewed under a lens. Hairs on undersides of leaves are collected and used medicinally as an emetic. If plant is considered as a weed, it may be controlled by soil management. It does well only in moist clay soils so drainage and enrichment control it.

Branching root systems serve a useful function in anchoring soil on steep slopes that might otherwise become badly eroded. Since these are easily destroyed by cutting or by cultivation, this suggests another common and simple means of control.



Fireweed

Common
Groundsel

German Ivy

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Fireweed, Pilewort
Erechtites hieracifolia

Height to 8 ft. Stem erect, smooth or downy, conspicuously grooved, branched with the branches turning upward. Leaves thin, to 8 in. long, pale green; the lower with clasping petioles, the upper without any; with margins deeply toothed to more than halfway to the midrib. Annual.

Native of North America, the West Indies, and South America. Widely established from Newfoundland to Florida, west to Texas, Mexico, and Saskatchewan. The only American species of the 12 in the genus, the others being native of Asia and the vicinity.

Flowers borne in more or less erect cylindrical heads at ends of branches, each head being to nearly 1 in. long and to $\frac{1}{4}$ in. through, with area at base rather conspicuously swollen. Flowers all fertile, greenish-white, and only slightly longer than the enclosing involucre. Fruit parachute, white.

Flowering time July through September. Fruiting time August through October. May become a weed in gardens and waste places. Once it has established a good crop of seeds in soil, it is persistent. Plants break too easily for hand pulling. Hoeing or cultivation seems about the only check.

It has been listed as a medicinal herb, the whole plant being pulled and dried just before blooming. It turns black on drying. Juices are rank to smell and offensive to taste. Dried plants have sold for about 2 cents per pound.

Common Groundsel
Senecio vulgaris

Height to $1\frac{1}{2}$ ft. Stem smooth or slightly downy, ridged, hollow, well-branched, easily broken, erect. Root system fibrous and well-branched. Leaves to 6 in. long, with margins roughly toothed, to halfway to midrib, with many smaller teeth all along the margin. Lower leaves petioled. Annual.

Native of Europe. Well-established in North America. From Newfoundland to Georgia, west to Pacific Coast. Does not usually form any dense clean stands as do some other weeds. Over 1,200 species of the genus of wide geographic distribution and, of course, of considerable variation.

Flowers borne in more or less erect heads somewhat crowded at ends of branches, each head being to $\frac{1}{2}$ in. high to $\frac{1}{8}$ in. through. No ray flowers. Flowers all yellow. Bracts of involucre slender, some black-tipped.

Flowering time April through October. Fruiting time May through November. Fruits wind-borne, with assistance of a generous fine white parachute of hairs. Where it is established as a weed, cultivation, hoeing, and use of modern weed-killer sprays are recommended procedure. Seeds should not be allowed to form.

Apparently weed does not have conspicuously important medicinal uses, nor is it so troublesome as to be taken seriously in most places. Not unattractive. White fruits could be considered worth seeing if one did not realize that they might produce weeds that would compete with our interests.

German Ivy
Senecio mikanoides

Stem long and twining, thin, smooth, and green arising from a mass of thin fibrous much-branched roots. Leaves 5-7-angled, lobed or nearly triangular, with sharp angles and a notched base, alternate, smooth, not toothed, apparently more abundant near base of the plant, pale green. Annual.

Native of South Africa. Found mostly as a greenhouse plant and in that capacity widely distributed. One of 2 species of *Senecio* that climbs, other being *S. scandens* whose flower heads have rays while in this species they are rayless.

Flowers, 12-15 in a head, with several heads in a cluster, none being ray flowers, greenish-yellow, with heads borne in close groups on branches springing from axils or from tips of branches. Bracts of enclosing involucre in each head are shorter than flowers themselves.

Flowering time indefinite because of greenhouse conditions. Plant propagated either by seeds as an annual, or by cuttings that root readily. Cuttings started in damp sandy soil and transplanted to medium garden soil. Plants need little sun; do best at temperature of 60-70°F. A common green aphid thrives on it.

An attractive ornamental for hanging gardens in sunrooms and in greenhouses, easily propagated. Easily cared for if it is sprayed occasionally with any good aphid control such as soapy water with some nicotine dust in it, or a nicotine fumigation process is used.



Burdock



Cornflower



Canada Thistle

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Burdock
Arctium lappa

Height to nearly 10 ft. Stem coarse, ridged, dark-green, strongly scented, much-branched, with soft pith when young, rather tough when old. Leaves alternate, relatively thin above, but lower leaves and rosettes may be coarse, long-petioled, to 1½ ft. long. Root system deeply penetrating. Biennial.

Native of Europe but thoroughly naturalized in America. This species and *A. minor* together occupy most of United States. This species may be a troublesome weed in waste places in the East and in the Middle West. Of the 6 or more species known for the genus, all are natives of Europe and Asia.

Flowers in heads, clustered at ends of branches. In this species, heads may be to 1½ in. across while in *A. minor* they are rarely half that width. Flowers all tubular; disc flowers with pink corollas are each capable of producing a fertile fruit. Anthers of stamens purple. Stigmas and pollen white.

Flowering time July through October. Fruiting time September through winter. First year spent in growing a rosette; second, in growing top and flowers. Under cultivation, seeds are sown 1 in. deep in fall. Seedlings thinned to 6 in. apart. Roots harvested at end of first year's growth.

1 acre may yield 1 ton of dried roots worth to 12 cents per lb. but there is little market and cultivation, harvest, and drying cost cut the profit. Ripe fruits sell for 10 cents per lb. Pith of young stems removed from outer portion tastes much like rhubarb and makes good greens. Roots and stems may be peeled, boiled, and eaten.

Bachelor's-button, Cornflower
Centaurea cyanus

Height to 2½ ft. Stems slender, branched, well-supplied with leaves, sometimes woolly when young. Leaves slender and almost grass-like, to 6 in. long, with lower ones sometimes obscurely toothed; the upper entire, alternate, grayish-green, and usually somewhat woolly. Annual.

Native of Europe. Probably introduced into America as an ornamental. Now escaped from cultivation and safely established in fields and waste places. From Quebec to Virginia and extending west particularly to the Pacific Northwest where it is most abundant. The 350 or more known species of the genus are all natives of the Old World.

Flowers borne in single heads at ends of branches, to 1½ in. wide and almost as high, though there are still larger cultivated forms. Flowers blue, purple, pinkish or white; flowers in margins of heads have large, almost fringed corollas, much larger than those of central flowers. Fruit uniquely lopsided at the base.

Flowering time July through September. Fruiting time August through October. Fruits retain their vitality for many years so it is important that plants be prevented from fruiting. They may be a really serious pest in grainfields of the Northwest. It is a long fight to eliminate the plants where once established.

Flowers used as rather long-lasting buttonhole bouquets. The name *Centaurea* refers to mythical centaurs who were reported to ascribe a medicinal value to the plant, which is not now so recognized. It is known as French pink, witchbells, brushes, hurt sickle, and bluebonnets.

Canada Thistle
Cirsium arvense

Height to over 4 ft. Stem straight, nearly smooth, somewhat woody, slender, grooved, green. Leaves alternate with crimped margins, well-supplied with vicious spines that break off easily, with clasping base; the basal to 8 in. or more long and petioled; the upper, smaller. Running horizontal rootstock. Perennial.

Native of Europe. Thoroughly established in America where it is found in any neglected place, in gardens, lawns, and grainfields as well as in meadows and pastures. Ranges from Newfoundland to Virginia, west to Utah and British Columbia. One of most persistent plants.

Flowers borne in many terminal medium-sized heads or in axillary heads, heads being about 1 in. through and 1 in. high, with fragrant purple flowers that may be pistillate or staminate, with two on separate plants. Corollas of flowers longer than bracts of enclosing involucre and so protrude.

Flowering time June through August. Fruiting time July through September. Fruits carried by wind because of their delicate feathery parachutes. So unpopular is this weed that it has long been legislated against. It apparently is not law-abiding and continues to prosper in spite of grubbing, cultivating, and spraying.

Modern weed-killer sprays may control the plant better than have earlier ones. Crop rotation with clover on occasion tends to discourage the plant. Goldfinches feed their young on the fruits in the milk stage and line their nests with the down. Peeled young stems boiled in salt water are delicious.



Strawflower



Globe Artichoke



Chicory

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Strawflower
Helichrysum bracteatum

Stout stems to 3 ft. tall, sometimes somewhat branched, minutely roughened, with scales that may rub off. Leaves numerous, up to 5 in. long, narrower near base and smooth or nearly so, dry and retaining form well when deprived of water. Roots relatively tough and fibrous.

Native of Australia but has established itself in gardens and in hearts of many Americans. Around 300 related species native of Europe, Asia, Africa, and Australia. Grown mostly as an "everlasting." It prefers rich loamy soil but does well where there is plenty of sunshine.

Flowers in terminal solitary disc-like heads, 1-2½ in. across. Red, white, yellow, brown, pink, or red, the colored portion being not the corollas of the flowers but the bracts which subtend the flowers. In related *H. petiolatum*, heads are clustered rather than solitary.

Seeds may be sown indoors or out and transplanted when danger of frost has passed. Seeds germinate in 5 days; live to 3 years. Plants should be thinned to 12 in. apart and cultivated frequently. Blooming should continue from July until frosts come. Many seeds are produced in each head. Common pests include aphids and tarnished plant bugs, controlled by a nicotine sulfate spray. Chief limitations to its more general growth are climatic. Favors moderate amount of moisture and does better in warmer climates.

Probably largest and best of everlastings. Flowers should be cut when half-open, in evening, for winter bouquets. Should be fastened in bunches and allowed to dry hanging downward in a warm room. May be arranged after they have dried. Bunches find ready sale at roadside stands.

Globe Artichoke
Cynara scolymus

From 4 ft. high, coarse, thistle-like, except that in this species leaves are only slightly spiny and bracts of head are unarmed while in cardoon, *C. cardunculus*, leaves and bract tips are spiny and the latter plant may grow over 6 ft. tall. Leaves large and variously lobed. Rootstocks produce offshoots after crown of year dies. Perennial.

Native in southern Europe and northern Africa and grown extensively, particularly in France. Popularity in America varies greatly. Has been cultivated in the South for over 100 years. Enjoys a wide range of soils, but does best on fertile deep well-drained areas. Must be protected in winter from heavy freezing by a cover, coal ashes proving popular.

Flowers borne at ends of main stem and of lateral branches, in heads to 3-4 in. through, with a fleshy base and thick bracts or scales. Flowers of cardoon, purple. Plants grown from seed do not "come true" so usual reproduction is by underground crowns. Fruits thick, smooth, 4-angled, seed-like.

Young plants selected when about 12 in. high as offshoots of parent plant, avoiding injury to parent root system. Roots set 6-8 in. deep and 6 ft. apart, with 8 ft. between rows, and cultivated. Freezing during growing may be fatal; heat may cause buds to open, ruining marketability. Greatest production in plants 2-3 years old; plantings renewed every 4 years. Manure is an unsatisfactory mulch as it causes rotting.

Large buds most desirable, so grading and packing is done, heads being packed in paper-lined boxes. Long-distance shipping in refrigerator cars with usual icing common for lettuce and similar vegetables. In desirable marketable heads, stem is cut about 1 in. below base of head. Old stems are cut off after last bearing, burned, used as silage or buried in field for green fertilizer.

Chicory
Cichorium intybus

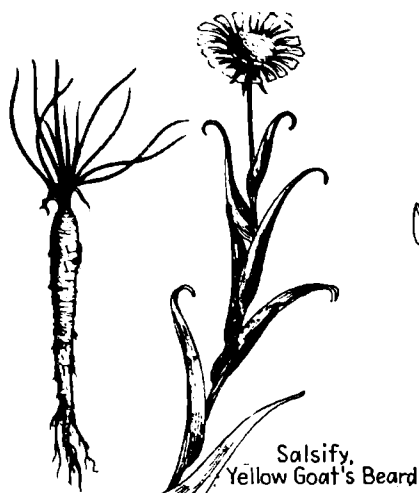
Height to 4 ft. Stems sparingly hairy, erect, relatively slender, hollow, well-branched, green but becoming purplish, then red, then brown; woody and tough when mature. Leaves somewhat dandelion-like, to 6 in. long, with deeply toothed margins; lower with long petioles, upper without. Perennial.

Native of Europe but firmly established in fields, waste places, gardens, and roadsides from Nova Scotia to North Carolina, west to California and Manitoba. Of the 8 species in the genus, all are native of the Old World. Only this one is well-established in America.

Flowers in showy heads, arranged along stem in upper areas. Heads to 1½ in. broad, usually somewhat grouped, with as many as 4 being close together, but only one in a cluster seems to be open at a time. Flowers all alike, blue or white, with notched tips, producing fertile fruits.

Flowering time July through October, usually in the morning. Fruiting time August through to end of year. Young leaves used as a slightly bitter salad plant. If tops are repeatedly cut and roots well-watered, a delicate green may be produced.

Roots dug just after flowering ceases, ground, roasted, and used as a coffee substitute or even as a deliberate adulterant of coffee. Some persons prefer it to real coffee. It was used as a means of extending coffee supply in the Civil War and in the World Wars.



Salsify,
Yellow Goat's Beard



Dandelion



Sow Thistle

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Salsify
Tragopogon porrifolius

Height to 4 ft. Leaves keeled like a boat, tapering to clasping, rather broad bases; in fact, leaves look almost grass-like. Plants smooth, dark-green, with long relatively slender taproots somewhat resembling those of parsnips. Biennial that requires a long first season to succeed.

Native of southern Europe and escaped in various parts of the world including North America. Also found in north Africa and central and southern Asia in closely related species, most of which are cultivated to some degree. Known to have been cultivated since 1600 in southern Europe.

Flowers purple or yellow, in large heads which close to form pointed cylinders, open in the morning but closed by noon. Fruits stick-like, crowned with a feathery yellowish down that serves as a parachute to help in distribution by wind. Flowers enclosed by green case except when it is expanded.

Seeds usually sown in drills from 12-15 in. apart, and plants are thinned to be about 2 in. apart in the row. Long season necessary makes it usual practice for roots to be dug in winter but some are dug earlier and stored, as are beets, turnips, parsnips, and similar root crops.

Because of "oyster" flavor, these plants have some popularity, but they never hold an important place in a commercial market. Their value probably warrants more general use. Roots marketed in bunches, usually tied at each end with tufts of leaves showing at the end. About 10 roots make a standard bunch.

Dandelion
Taraxacum officinale

Height of flower stalk to 1½ ft. A stemless plant, leaves rising directly from top of coarse bitter thick root that may be well over 10 in. long. Leaves to 10 in. long and to 2½ in. wide, narrowed at base into petioles, but with deeply toothed margins, with many teeth curving backward. Perennial.

Native of Europe. Thoroughly established in North America in lawns and waste places. Native of Asia. Found in Southern Hemisphere as well as in Northern. In North, there is a closely related red-seeded dandelion that is much less common than this species.

Flowers yellow, all bright yellow straps, with the ends notched or toothed. All with stamens and pistils. Would seem that pollination would be effected either by self or by insects but pollen is sterile and there is no true pollination or fertilization. As a result, plant can produce seeds that germinate without trouble.

Flowering time January to December. Fruiting time the same. Cultivated for a drug, 1 acre needs 3 lb. of seed drilled in rows 18 in. apart. Roots dug second season, washed, dried, and cut into 3-6 in. sections. 1 acre may yield ¼ ton, worth to 19 cents per lb. United States takes about 65 tons a year.

As a weed, this plant is a bother to those who like uniform green lawns. Can be easily eliminated by the newest of the weed-killed sprays but treatment must be repeated because new crops are sown by wind each year from untreated adjacent territory. Leaves make an excellent potherb.

Sow Thistle
Sonchus oleraceus

Height to 10 ft. Stem only slightly branched, weak, erect, somewhat juicy, smooth, green, hollow between joints, with milky juice, angled, arising from a deep white taproot. Leaves alternate, deeply toothed or lobed with smaller teeth around the margin, the lower with petioles and with bases clasping the stem, provided with weak spines. Annual.

Native of Europe. Well-established through most of North America except extreme north. Also established in Central and South America. Too common a weed in cultivated lands, particularly in gardens as well as in waste places. Will grow in lawns that are not mowed frequently. About 45 Old World species in the genus.

Flowers borne in rather crowded heads at top of plant. Individual heads over 1 in. across, with a broad base on which are crowded 50 or more pale yellow flowers, all ray flowers with notched tips. Fruits red or brown, carried by wind by a dirty white parachute.

Flowering time June through September. Fruiting time July through October. Since plant is annual, one of best control measures is to keep tops cut back each year before they have time to fruit, so that any seed supply in soil may eventually be destroyed. Fall plowing and cultivating help control also.

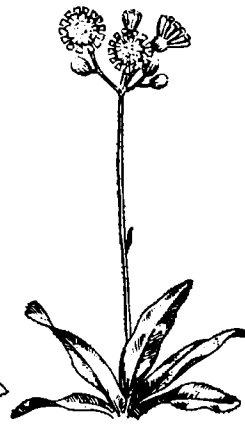
While juices of plant are definitely bitter, young leaves may be made into a pleasant-tasting green if boiled, the water removed, and the material well salted. It is more popular as a food in Europe than it is ever likely to be in America.



Lettuce



Wild Lettuce



Orange Hawkweed

PHYLUM SPERMATOPHYTA. CLASS DICOTYLEDONEAE
Order Campanulales. Family Compositae

Garden Lettuce
Lactuca sativa

Stem to 4 ft. high, well-supplied with leaves, branching above. Basal leaves crowded, to 10 in. long, forming a more or less compact ball depending on variety, and varying in texture, shape, and color. Root relatively deep. Varieties include 3 classes: butter, including Boston lettuce; crisp, including Iceberg; and Cos. Annual.

Native of Europe and Asia. Has been under cultivation for 2,500 years, being mentioned by writers in 500 B.C. Grown in almost every home garden. Favors a cool growing season, and to do best has rather definite requirements for water.

Flowers borne in erect, yellow heads, open in forenoon and close in afternoon; produce a flattened seed-like fruit, blown by wind with help of downy parachute. Fruit either straw-colored, brown, or black. 12-16 flowers or fruits per head, fewer than in related sow thistle. High temperatures cause premature seeding and lessen commercial value.

Seeds do not germinate well at above 80°F. so may be iced 4 days before planting. Seeds 2 lb. per acre, when rows are 14-18 in. apart and thinning is to be to 10-18 in. between plants. Thinning should not be delayed. Cultivation avoided when plants are well-grown and should be shallow. Can be stored at 32°F., if not harvested after rain, for from 3 to 4 weeks.

Value of lettuce raised in United States greater than for any other vegetables except tomatoes and potatoes, the leading states being California and Arizona, which produce about 80% of the commercial crop, followed by Colorado, New York, Washington, and Oregon.

Wild Lettuce
Lactuca scariola integrata

Height to 7 ft. but usually shorter. Stems erect, with short side branches, green, smooth, relatively weak, smooth or with weak bristles at base, with milky juice. Leaves alternate, light green, with waving margins and prickles along the margins along the midrib below, clasping at base. Annual.

Native of Europe. Widely established in North America from coast to coast in United States except in the southern areas. Found on all sorts of soil, usually in the open and where there is a good sun exposure. Many races and varieties differing largely in leaf characters. In most, leaves are deeply toothed.

Flowers borne in open clusters of heads at or near top of plant. Heads under ½ in. through; contain only from 6-12 flowers, or fewer than in sow thistles. Heads accordingly much narrower. Uppermost flowers open first and as the season advances lower flowers mature. Fruits ridged, brown, with parachutes.

Flowering time July through October. Fruiting time August through November. Plants, when young, used as a salad substitute, and may easily be accepted as a desirable potherb. Since plant is an annual, it can be kept under control by preventing tops from forming fruits.

Cultivation, hoeing, and use of the modern weed-killer sprays are usually sufficiently effective to keep this plant under control. This variety is generally more common than species with its more deeply cut leaf margins.

Devil's-paintbrush
Hieracium aurantiacum

Height to 20 in. Stem usually without leaves but bearing heads of flowers at top, not profusely branched, well-toothed, covered with hairs, slender. Leaves mostly in tufts at base of stems, entire or obscurely toothed, hairy, conspicuously veined, to 5 in. long and to 1 in. wide. Sprawling stems take root. Perennial.

Native of Europe. Altogether too well established in certain parts of North America. Known well from New Brunswick to Pennsylvania, west to the Corn Belt. Related species occupy same range and extend it west. Over 300 species of the genus native of North Temperate Zone and of higher lands of South America.

Flowers borne in few or several crowded heads at top of erect flowering stems. Each head is to 1 in. broad and composed of brilliant orange-red flowers that open or close with intensity of sun. Rays toothed at tips. Involucre that encloses heads composed of 2-3 rows of hairy bracts.

Flowering time June through September. Fruiting time July through October. A real weed pest on poor farm lands. May occupy soil to exclusion of other plants because soil is too poor to provide competition from normal plants of the area.

Control may be by means of destructive measures such as sprays, salting, and the like, but a better procedure seems to be to use fertilizer and stimulate rival plants that if well-nourished will quickly crowd out this offensive but beautiful plant. In a sense, presence of plant is a sign of poor soil management.

The Animal Kingdom

The primary divisions of the animal kingdom are the phyla. Each phylum is divided into sub-phyla, which in turn are made up of classes. The classes are groups of orders. Some orders are subdivided into suborders but all contain one family or more. The families are divided into genera which may in turn be divided into subgenera. In each genus there is one or more species, of which there may be two or more subspecies. Some zoologists use the terms *variety* and *subspecies* interchangeably, but modern usage inclines toward restricting the term *subspecies* to populations that differ from each other in hereditary qualities, while *varieties* represent differences brought about by environmental factors such as temperature, humidity, and differences in food. Subspecies, then, are geographic races and in many cases are doubtless incipient species, that is, species now in actual process of differentiation. They are separated by barriers that act to reduce or prevent interbreeding between the populations on the two sides. Most of our species of birds and mammals are divided into such geographical subspecies. In many cases the Rocky Mountains form a barrier between our subspecies. The lower Mississippi effectively separates two subspecies of the ribbon snake. The isthmus of Panama, of comparatively recent origin geologically, has brought about differentiation of certain fishes on its two sides. The great arid regions of our Western states constitute another important barrier; in addition, these deserts have a characteristic population of their own.

Breeds are limited groups resulting from selective breeding controlled by man. *Strains* are even more limited than breeds. Attempts by systematic zoologists to agree on the definition of these terms has led in the past to endless but not necessarily futile discussion.

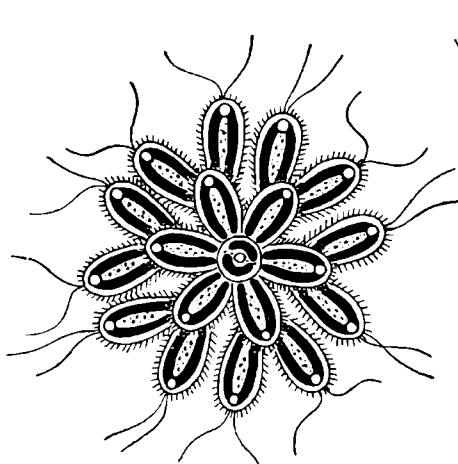
There are probably several million species of animals, of which only about $\frac{1}{5}$ of a million are known to science and slightly less than 1,000 are considered here.

PHYLA OF LIVING ANIMALS

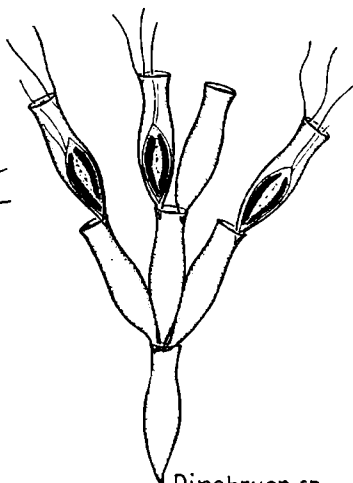
Phylum	Probable number of species in phylum	Number of species in this book	Pages
Protozoa.....	15,000	6	343-344
Porifera.....	3,000	3	345
Coelenterata.....	9,500	6	346-7
Ctenophora.....	100	0	
Platyhelminthes.....	6,000	1	348
Nemertea.....	500	0	
Nemathelminthes.....	3,000	2	348
Trochelminthes.....	1,200	0	
Bryozoa.....	3,000	1	349
Brachiopoda.....	120	0	
Phoronidea.....	15	0	
Chaetognatha.....	30	0	
Annelida.....	6,500	2	349
Echinodermata.....	4,800	6	350-351
Mollusca.....	70,000	118	352-368
Arthropoda.....	640,000	198	369-435
Chordata.....	60,000	612	436-641
Total.....	About 823,000	955	343-641

The table shows that the common animals we notice in the field belong to relatively few groups and are unevenly distributed among these groups. If the number of woodchucks that could survive on a 10-acre lot were put end to end, they would probably reach less than 100 ft. The microscopic nematode worms that might live unseen and comfortably in the same area if placed end to end might well reach around the earth. Most of us on a field trip see the woodchucks. Few if any would see the nematode. We notice the color, odor, luminescence, taste, or feel of some of the smaller animals and for this reason a few are mentioned in this field book.

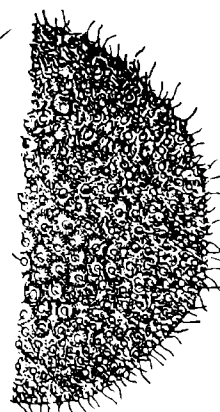
Agriculture, medicine, commerce, conservation, health, and government are all dependent on an understanding of the interrelationships that exist between different animals, plants, and types of environment. The understanding necessary for continued successful civilization may in large part be developed from work in this field.



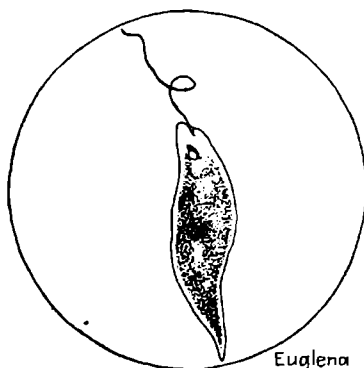
Synura sp.



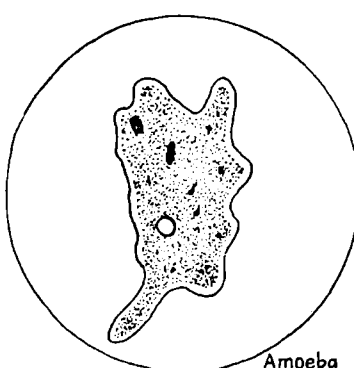
Dinobryon sp.



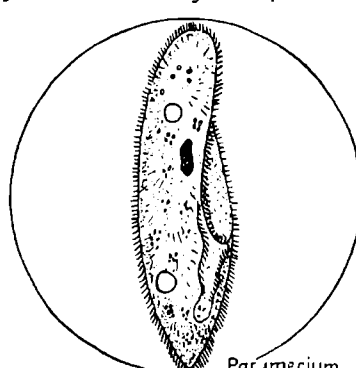
Uroglena sp.



Euglena



Amoeba



Paramecium

PHYLUM PROTOZOA

Some 15,000 species of Protozoa are known to science. The only other large groups of animals are the arthropods (pp. 369-435), the molluscs (pp. 352-368), and the chordates (pp. 435-641).

The Protozoa are minute 1-celled animals, aquatic or parasitic, without special body or sense organs but with specialized structures having particular functions. The animals live singly or in colonies and may move with or without the help of whip-like structures called *cilia* or *flagella*. Respiration and excretion are carried on through the body surface and solid food may be similarly engulfed. The outer covering, when present, is not made of cellulose as are the cell walls of plants. Some of the primitive Protozoa bear chlorophyll; they are claimed as plants by botanists and as animals by zoologists since they have some of the characters of each. They were first studied by Leeuwenhoek with his microscope in 1674 and the name Protozoa was first used by Goldfuss in 1820.

Two subphyla are represented here, although it is not easy to recognize the differences since a colony of animals, each of which has a few flagella, may appear like a single animal with many cilia. *Paramecium* belongs to the subphylum Ciliophora, while the others belong to the nonciliate Plasmodroma.

Of the other Protozoa shown here, *Amoeba* moves by pseudopodia, or false feet, and belongs to the class Sarcoda while the others move with the help of flagella and belong to the class Mastigophora. Animals of a third class, the Sporozoa, usually possess no organs of locomotion. However, they are important and cause many diseases of other animals. Of these *Plasmodium*, the cause of malaria, is carried by certain mosquitoes (p. 421) and *Babesia*, the cause of Texas fever is carried by ticks (p. 380).

Few persons interested only superficially in field natural history will ever see individual *Synura*, *Dinobryon*, or *Uroglena* although they recognize their presence. They foul stagnant waters such as swimming pools.

Synura is found in stagnant fresh waters. It makes such waters smell like ripe cucumbers. An individual is about $\frac{1}{1000}$ in. long. Water abounding with this animal has a

bitter, spicy taste and is undesirable for drinking purposes. The odor or taste is due to the freeing of aromatic oils so strong that one can detect by odor the presence of 1 part of the oil in 25 million parts of water. Copper sulfate in the water will keep the animals down and if used in small quantities will not harm the water for drinking purposes.

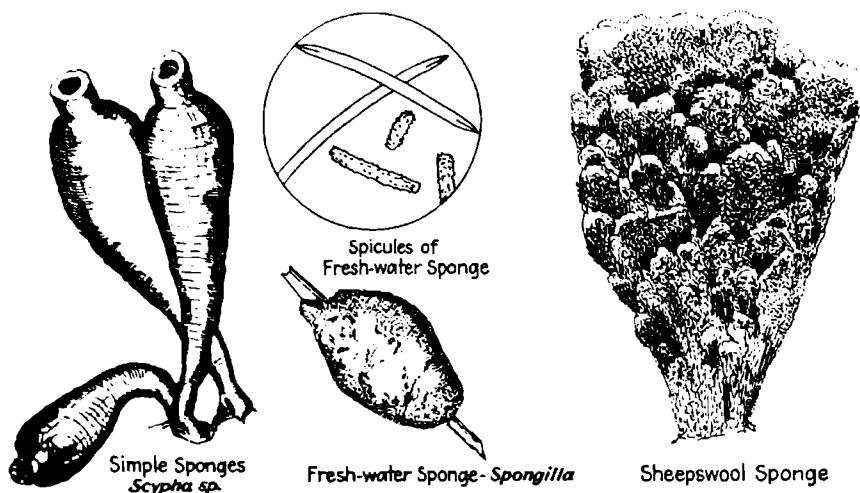
Dinobryon, also found in fresh water, gives the water a fish-like odor and commonly fouls waters in reservoirs and ponds.

Uroglena, found in drinking water, gives flavor like that of cod-liver oil. An individual is about $\frac{1}{25000}$ in. long.

The green color appearing in stagnant water in late summer may be due to a number of protozoa, among them *Euglena*. Some relatives give a red color to snow in various parts of the world and some give a yellowish cast to sea water. *Noctiluca* may color the sea red or yellow by day and may glow with intense phosphorescent light at night, particularly in the wakes of vessels or animals moving over warm seas. In the Mediterranean there are about 4 billion protozoans to every quart of water, some being found at depths of over 3,000 ft. For the most part these creatures serve a useful function as basic food for larger organisms or in breaking down undesirable compounds.

Many microscopic living things inhabit the soil. In 1 acre of rich soil there should be about 250 lb. of bacteria and an equal weight of microscopic animals and fungi. A single gram of such soil might well contain close to 10,000 individual animals. Representative of these is *Amoeba*. At least 6 genera and many more species of amoebae are found in fresh water and in salt water. Many of these are within bodies of animals, one being the cause of amoebic dysentery in human beings. This disease might easily be a critical factor in deciding a war or in maintaining a successful peacetime economy. Other amoebae are highly useful in preserving the fertility of the soil by assisting in the breakdown of certain organic compounds.

Of the Ciliata, we show *Paramecium*, commonly studied in beginning biology classes. There are some 2,500 species of ciliates, often spoken of as Infusoria because they are commonly found in hay infusions.



PHYLUM PORIFERA

The Porifera are aquatic animals that live attached to the bottom. 2 classes: the Calcarea, which are marine and mostly under 1 in. long, reinforced with lime; and the Noncalcarea, which are usually larger and reinforced with silica or spongin or both, or may be without either.

CLASS CALCAREA

Order Heterocoela Family Grantiidae

Simple Sponges

Scypha coronata

Length about $\frac{3}{4}$ in. Like a slender goblet or vase, with central cavity connected with the outside by numerous canals through which water is kept in motion by whip-like flagella. Mass supported by spicules of harder material. Attached to ocean bottom.

Related classes include larger commercial forms. Found attached to rocks in shallow salt water, but some are found in fresh waters on submerged objects. Some 400 species of Calcispongiae, nearly 10 times that number in other groups, and many others as fossils. They date back to Pre-Cambrian times.

Reproduction by budding, by formation of gemmules, which survive drying when parent colony dies, or by sexual reproduction. Animal produces both male and female cells in jelly-like middle layer. Eggs become fertilized and after some development are freed as free-swimming units, which finally settle down and start a new colony.

Feeding by extracting food from stream of water forced through canals in walls and out through opening at top. A good-sized sponge may force a gallon of water an hour, day in and day out, through itself. Subject to number of diseases and in some parts of world have practically vanished.

Too small to be of great economic importance, but interesting to zoologists because of relative simplicity. They may be listed in materials furnished by biological supply houses and may find a limited market for this purpose.

CLASS DESMOSPONGIA (NONCALCAREA)

Order Monaxonida Family Spongillidae

Fresh-water Sponges

Spongilla fragilis

Usually yellow or brown but sometimes forms green patches of spongy material on objects in standing or in running water. *S. lacustris*, the commonest fresh-water sponge, is branching and usually green, while *S. fragilis*, next most common, does not branch.

S. lacustris found typically in sunny, running water in late fall. *S. fragilis*, in standing or running water where there is no direct sunlight for long periods of time. Relatively common *Ephydatia fluviatilis* found either in still or in running water. Some members of family are found in brackish water and some in water 200 ft. deep.

Fresh-water sponges usually die and disintegrate in autumn, forming gemmules, which have hard coverings and live over until next spring. Gemmules may survive drying for over a year and may survive extremely cold weather. Young leave parent body as swimming larvae.

Green color in these sponges is due to zoochlorellae. While common fresh-water sponges appear as shown, some are cushion-shaped (as *Ephydatia mülleri*). They vary greatly in color and in site selected for growth.

Food, minute animals. Sponges may themselves be food for larger animals, although they are of little economic importance.

Order Keratosa Family Spongiidae

Bath Sponges

Euspongia officinalis

Skeletons of these animals are well-known in homes and in commerce. Common sponge used on automobiles is horse sponge, *Hippospongia equina*, while the more delicate household sponge is the bath sponge, *Euspongia officinalis*. Fibers are of spongin, often with sand embedded; they enclose cavities of variable size; cavities large in the horse sponge, and smaller in others.

Marine animals. Best bath sponges are from Asia Minor and are highly elastic and light yellow; but they are also found in the Bahamas, West Indies, and Australia. Florida and Bahamas produce sheep's-wool sponge, *H. gossypina*; and Florida, the West Indies, and the Mediterranean produce horse sponge.

Young bath sponge may have a conic form and one opening; but with maturity it becomes broader with many openings. Sponges may live at least 50 years. Commercially attempts have been made to plant them by attaching small portions to sunken concrete blocks. Sponges can regenerate lost parts and may reproduce sexually or by budding.

Feeding habits are much like those of other sponges.

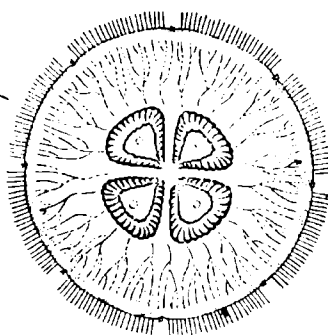
Commercial sponges are worth around 5 million dollars a year. Collected by diving or hooking in summer months. Dredging destroys young animals and is poor conservation practice. Animals are allowed to die out of water and are then rotted in water, beaten, squeezed, and washed under water; then dried, bleached, trimmed, and packed.



Hydra



Portuguese
Man-of-war



Common Jellyfish

PHYLUM COELENTERATA

Coelenterates are among the lowest many-celled animals. They are radially symmetrical, with 3-layered walls, a single internal cavity, and few specialized organs or tissues. Some reproduce sexually and asexually, in strict alternation of these types. Most get their food by use of tentacles provided with nettle organs that help in subduing prey.

CLASS HYDROZOA

Order Hydrariae

Hydra *Hydra littoralis*

Body about $\frac{3}{4}$ in. long, with tentacles to $1\frac{1}{2}$ in. long. Pinkish or greenish-orange. Attached at base but free at head end. In 6 common species, 4 have individuals either male or female, while 2 have both sexes in the same individual.

Relatively common in fresh water, attached to bottom or to objects on it. 5 American species described. Related green hydra *Chlorohydra* bears green algae in outer layer. Brown hydra *Palmatohydra* has lower portion of stalk narrowed. Former common in America and Europe, latter most numerous in central states.

Reproduction by budding or sexually, latter commonest in fall. Egg (embryo), surrounded by sticky shell, may drop to bottom or stick to objects. Tentacles of 4 types; one holds prey with netting cells that paralyze it, one coils and helps in locomotion, and one holds animals fast.

Food, small animals captured by tentacles, sometimes including fish fry; in hatcheries they may be pests. Are themselves food for larger animals. Commonly studied in beginning biology classes as representatives of primitive structure, reproduction, defense, food getting, and so on.

Order Siphonophora

Portuguese Man-of-war *Physalia physalis*

Appear like blue elongate bladders with mass of long streamers beneath. Appear on surface of sea or washed on shore and are about 4-5 in. long, with wrinkled crest. Tentacles beneath may be 50 ft. long and of many types, some relatively short and straight, others long, slender, and frequently coiled.

Often common in Gulf Stream from Florida to Bay of Fundy. Pacific Coast animal is *Velilla lata*, which looks like a dark blue oval elliptical raft, with a clear triangular sail above and short tentacles beneath. Pacific Coast form belongs to suborder Disconectae, while Atlantic Coast form, with about 30 other species, is of the suborder Cystonectae.

Colony of specialized individuals. Some are umbrella-like and produce eggs and sperms which are involved in sexual reproduction but are not freed from colony. Others serve in moving or in capturing food. Stinging tentacles can sting a human worse than many wasps. These sting fishes and other animals and bring food to colony for consumption.

Dangerous to swimmers or beachcombers who may handle them. Commonly noticed from ships particularly in Gulf Stream. Bladders may be inflated or deflated at will, much to amusement of ships' passengers who watch them from decks. Of little direct economic importance but interesting to zoologists.

CLASS SCYPHOZOA

JELLYFISH

In most of these, there is alternation of generations, in which the free-swimming medusa stage is usually more conspicuous than the hydra stage. Hydra stage may be less than $\frac{1}{2}$ in. long while medusa stage may be 6 ft. across top of "umbrella," with tentacles over 100 ft. long. All are marine; relatively common on shores and offshore.

At least 5 orders, of which Stauro-medusae have no free-swimming medusa stage, Coronatae have constriction about middle of umbrella, Rhizostomae have no tentacles on margin or subumbrella, Cubomedusae have 4 long marginal tentacles or tentacle groups, and Semaestomae have 8 or more marginal or subumbrella tentacles.

Order Semaestomae

Of 3 families here considered, Pelagiidae have long marginal tentacles, Ulmaridae have short marginal tentacles, and Cynaeidae have long subumbrella tentacles but no marginals. May grow from 1-in. diameter in April to full size in July.

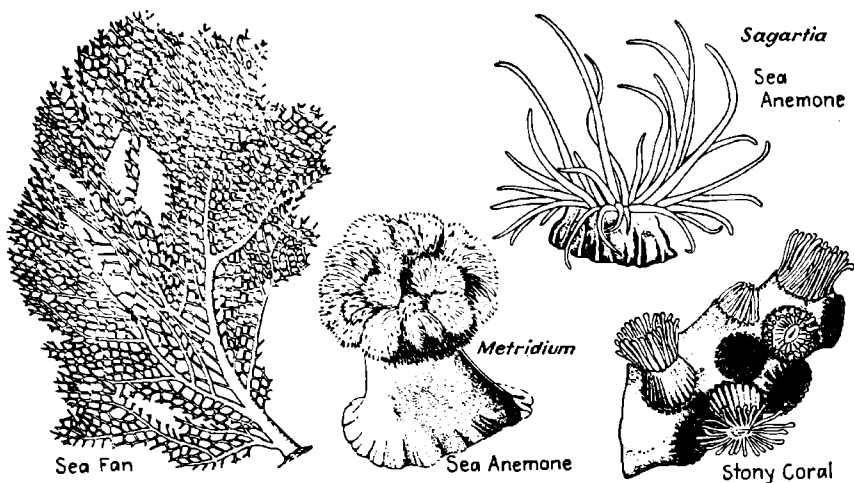
Family Ulmaridae

Common Jellyfish

Aurelia aurita

Disc may be 10-35 in. (in some species 7 ft.) across. Color white or bluish with pink sex organs. Body flat, with 4 large pockets that curve toward center and 8 marginal indentations. 10 genera in family and 5 species in genus. Eyes and nerve centers in notches on margins. About $\frac{1}{20}$ of body weight is solid. Some species flash lights in wakes of ships.

Found in Atlantic and Pacific Oceans, breeding in summer and sometimes lasting through winter. In Britain it may survive being frozen in ice, but this is fatal in Florida. Specimens from Halifax die at 29.4°C., which is temperature at which some Florida individuals are most active. Some are eaten. Sting.



PHYLUM COELENTERATA. CLASS ANTHOZOA

In this class, no medusa generation is present. Body attached sometimes permanently to foot. Mouth a slit at opposite end surrounded by hundreds of hollow tentacles. Most of the class have horny skeletons and most animals have only one sex. All of the 6,000 living species are marine.

Order Alcyonaria

Of the suborders, Pennatulacea, sea pens and sea feathers, are capable of independent movement while others are not. Gorgonacea, including red corals and sea fans, are stationary and have a central axis. In latter, family Corallidae include red corals which are hard and branch profusely, while Gorgoniidae or sea fans are more erect and usually branch in one plane. Red corals are the coral of commerce used in jewelry and otherwise.

Family Gorgoniidae

Sea Fan *Gorgonia flabellum*

Colony like a fan or flattened tree, up to 20 in. high with meshes up to $\frac{1}{4}$ in. across. Yellow or red, though living animals are themselves yellowish-white. Horny material is a protein, lower in sulfur content than true horn such as is found in vertebrates.

Found in shallow seas in West Indies and South Atlantic. Sea fans sold for ornaments and serve as bases for other marine animals. Substance gorgonin which forms "backbone" is replaced by solid calcium carbonate in red corals. Lend unique beauty to warm seas by color. Some are phosphorescent.

Commercial red corals at best in Mediterranean and off Japan. Horny relatives of sea fans are known from Tertiary times and calcareous relatives of red corals from Cretaceous, though red corals are not themselves known as fossils.

Order Zoantharia

Order includes suborders Actiniaria or sea anemones, which lack hard skeleton; the Antipatharia or black corals, which have horny skeleton; and the Madreporaria, which have skeleton of lime. Some 4,000 known species. Single animal (polyp) may have several hundred tentacles which bring water and food to it. David Starr Jordan's "The Story of a Stone" in *Science Sketches* is an excellent summary of a coral's life history.

Suborder Actiniaria

About 1,000 sea anemones; some free-swimming but most attached by a broad sucker foot. One group, the Edwardsiidae, have 8 longitudinal ridges on outside of body. Others have at least 12, or no such ridges. Of these, the Ceriantheae are slender and burrow in mud; the Zoantheae are colonial. Remaining group, the Hexactiniae, are here represented by two species.

Family Sagartiidae

Sea Anemone

1. *Sagartia* sp.
2. *Metridium dianthus*

(1) *Sagartia leucolena* with body to 2½ in. long and to $\frac{1}{2}$ in. through; with translucent fleshy color and 96 retractile tentacles in 4 rows. (2) *Metridium dianthus* with length to 4 in. and width to 3 in.; varies from brown to yellow and is one of the largest and commonest Atlantic Coast sea anemones.

Animals serve as food for a few larger forms of marine life, but some are avoided because of their stinging tentacles. Members of one genus, *Adamsia*, become fixed to backs of hermit crabs or other crustaceans and are moved about by them; provide some protection for their bearer and in return may share his meal.

Suborder Madreporaria

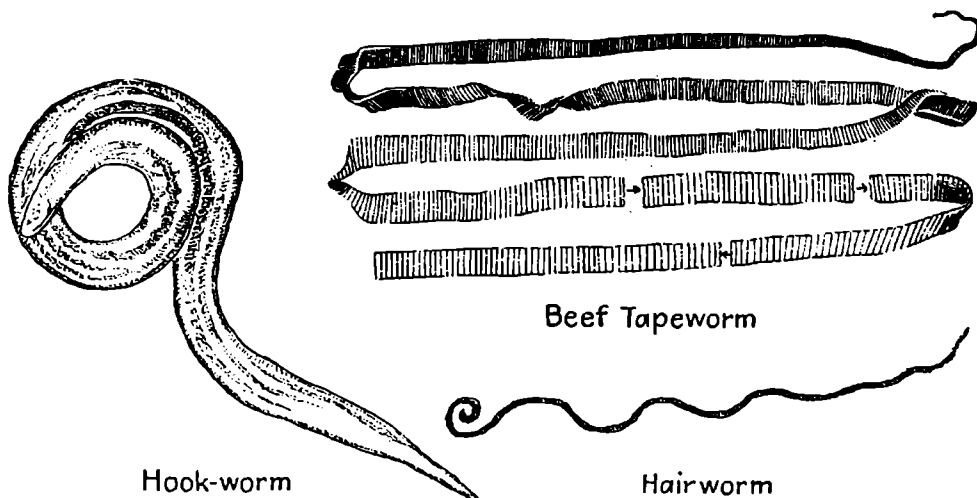
Some 2,500 known stony corals, associated for most part with formation of coral reefs. Included are Perforata, which make porous coral, and Aporosa and Fungacea, which make solid coral. Some important reef builders are in first group. In a sense, they are like sea anemones, living in stone boxes which they themselves make.

Family Astraeidae

Stony Coral *Astrangia danae*

This small coral is found in small colonies of as many as 30 animals, which appear like clinging crusts. Reproduction is by budding or by free-swimming units which settle down to start new colonies. Colonies of different stony corals appear in variety of forms, branching, encrusting, solid blocks, and so on.

Most important aspect of corals is their reef-building habit, which makes great harbors. Japan fortified them and used them as unsinkable airplane carriers, with varying success. These harbors provide excellent way stations for airplane traffic. Some corals make serious poisonous sores on swimmers.



Hook-worm

Beef Tapeworm

Hairworm

PHYLUM PLATYHELMINTHES FLATWORMS

These soft flat or cylindrical worms lack a body cavity, a distinct head, or paired appendages for the most part. In some, even a mouth is lacking and there is no circulatory or respiratory system. 3 classes: free-living Turbellaria, which have bodies with external cilia; and parasitic Trematoda and Cestoidea. Trematoda are flukeworms, with a mouth and intestine, but small and unsegmented. Cestoidea are tapeworms, with no mouth or intestine but with segmented bodies. Over 6,000 species.

CLASS CESTOIDEA Order Cyclophyllidea Family Taeniidae

Beef Tapeworm *Taenia saginata*

To 30 ft. or more long, with over 1,000 segments each under $\frac{1}{8}$ in. long (except end ones which may be nearly 1 in. long) and containing reproductive organs. Head end smallest, with hooks useful in holding worm to lining of host's alimentary tract. Both sex organs in a single segment.

Terminal reproductive segments become freed in dung of host. From these escape hooked embryos that may be eaten by cattle. Develops in flesh of cattle and goes into resting stage. If this muscle is eaten poorly cooked or raw by man, the creature develops to maturity in man's alimentary canal.

Commonest human tapeworm. It robs human beings of their food and may make them subject to disease, though worm itself rarely causes fatal injury. Control is effected by eating only clean well-cooked meat or by freeing animal from its hold and then flushing it out with a physic. Cattle may be restrained from eating grass growing in dung and thus avoid infection.

PHYLUM NEMATHELMINTHES. ROUNDWORMS

These slender, unsegmented, long worms have bodies free of cilia and without paired appendages, though there may be bristles, hairs, or suckers. Some 3,000 species included in 3 classes. Acanthocephala have spiny proboscis and no intestine; they are not considered here. Nematomorpha have no spiny proboscis or lateral line but do have an intestine; here represented by "hair snakes," which children and others frequently try to develop from horsehairs submerged in water. Nematoda have an intestine and lateral line but no spiny proboscis; here represented by hookworm, which so frequently infects poorer people of South who go barefoot. Class also includes vinegar worm seen wriggling in vinegar; ringworm, which so frequently causes a skin disease; trichina, which causes trichinosis and sometimes death; whipworm, which may indirectly cause appendicitis and typhoid fever, and hundreds of other worms which swarm in our environment. Much hygienic practice is directed primarily toward avoiding infestation by these worms. Some serve a useful function in soil biology but many injure both plants and animals with which they come in contact.

CLASS NEMATODA Order Telogona Family Ancylostomidae

Hookworm *Necator americanus*

Length of some, female $3\frac{1}{2}$ in., male $\frac{1}{2}$ in. White. Head end narrower than body, curved backward. Mouth large, with oblique opening above and with cutting teeth or plates and 2 lips on lower margin; upper portion separated by conical tooth which projects into it.

Eggs pass out of host in dung. Young worms live in water or moist earth and infect new host by piercing skin of feet, or by being ingested in drinking water or on infected substances (such as unclean garden vegetables). Young bore into blood vessels, are carried to heart and lungs, then to throat; later become attached to walls of small intestine.

Probably about 2 million residents of United States are infected with hookworm; more in other countries. Going barefoot, eating infected food, or drinking infected water are common sources. Human wastes should be disposed of safely. Oil of chenopodium, tetrachlorethyl, or carbon tetrachloride are used as drugs to drive worms from infected body.

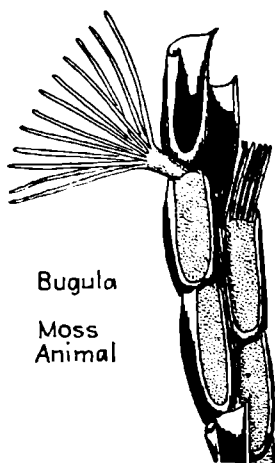
CLASS NEMATOMORPHA Order Gordioidea Family Gordiidae

Hairworm. Hair Snake *Gordius lineatus*

Some hairworms are over 2 ft. long, though this species is shorter. Male has V-shaped ridge at end; this is lacking in female. Commonly found in water or on wet vegetation or inside insects and other animals, often coiled into a "Gordian knot," which gives animal its name. Food absorbed through body wall.

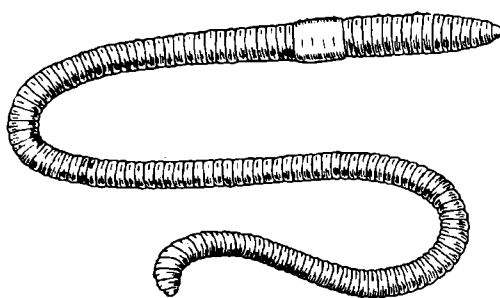
Eggs laid in water in strings, in some species 8 ft. long and numbering to 6 million; hatch into larvae; these enter some water insect and develop to resting stage. If host is eaten by fish, bird, or insect, next stage develops into typical worm, which lives in alimentary tract of host until mature, then leaves host, enters water, mates, and lays eggs.

Interesting example of parasitic worm whose life history is not understood by layman, who will readily believe fanciful theory rather than accept discovered fact. Some who will not accept the theory of evolution readily believe that a horsehair can turn into this worm even though attempts to prove it always fail.



Bugula

Moss
Animal



Earthworm



Leech

PHYLUM BRYOZOA.

MOSS ANIMALS

Some 3,000 marine and 35 fresh-water species of living Bryozoa, and thousands of fossil species. Commonly occur in colonies of thousands of animals. Each animal usually small, cylindrical, and partly surrounded with a hard or limy wall which persists after death.

CLASS ECTOPROCTA

In the Class Entoprocta, tentacles cannot be withdrawn; in the Ectoprocta in which our representative is found, they can be. Fresh-water Ectoprocta belong to order Phylactoloemata; marine forms, to Gymnoloeemata.

Order Gymnoloeemata Family Bugulidae

Bugula *Bugula turrita*

Branching, lime-like tufts, with branches in spirals, the whole forming dense clusters 1 ft. or more across. Lower stem often yellow or orange; upper parts, white or yellow. Bird-like head appendages show under microscope.

Common between low-water marks and to depth of 100 ft., covering rocks and piles from North Carolina to Maine, with many other kinds found throughout the world.

Young partly developed within parent body, freed through opening, swim about near surface, then settle and start a new colony which develops by budding. Two ends of digestive tract are near each other. Tentacles capture food and help in water circulation. Special cells, with bird-like beaks, capture minute living things for food. No locomotion after colony is fixed. Intercommunication between colony members possible although there is no nervous system. No special sense organs.

Have slight value as food to some marine animals. Have been considered as seaweeds, then as corals and hydroids, and now as a degenerated group of animals. True nature recognized about 1830.

PHYLUM ANNELIDA. ANNELID WORMS

Some 6,500 species of living annelid worms. Have elongate segmented bodies with distinct heads, digestive tract, and commonly paired unjointed appendages. 5 classes, some of which have common well-known forms. Hirudinea or leeches have suckers at either end and bodies with external rings. No other classes have suckers. No setae, such as appear like fine bristles beneath earthworms, in the class Archiannelida. Remaining 3 classes with setae. The Gephyrea lack distinct body segmentation when adult and are marine. The Polychaeta have distinct body segmentation and are marine. The Oligochaeta, including the earthworm, are fresh-water or terrestrial, and have definite body segmentation.

CLASS OLIGOCHAETA

Some 2,500 species divided into 14 families. Some in Australia reach a length of 11 ft. Individuals bear both kinds of sex organs; many may regenerate parts in case of injury. Generally poorly supplied with sense organs but can detect vibration and light.

Order Megadrili Family Lumbricidae

Earthworm *Lumbricus terrestris*

Up to 11 in. long, with pointed head end and flattened tail end. Sex organs: those of male open in fifteenth segment; of female, in fourteenth. Bristles on underside together with secreted mucus enable animal to climb even on smooth glass. Body can be retracted into burrow quickly when necessary.

Animal burrows underground but feeds outside, mostly at night on decaying organic material. Favors damp soil and is found in Europe, America, and other temperate regions where conditions are suitable.

2 individuals mate by placing sperm in receptacles in each other, each individual lying with head toward partner's tail. After mating a secreted cocoon is shed over head, taking with it eggs of one and sperms of other. Eggs hatch 2-3 weeks after fertilization in cocoons; young worms like adults in general appearance. Animals are sensitive to soil vibrations and may be brought to surface by vibrations of post driven into soil.

Darwin contended that 1 acre may contain 50,000 earthworms which in a year may bring 18 tons of soil to surface and in 20 years build a new 3-inch layer. Do not "rain" down as is sometimes supposed; rather are drowned up.

CLASS HIRUDINEA

About 250 species of living leeches, divided into 2 orders. Mostly aquatic, or in moist places, in most parts of world. Suck blood of other animals, particularly of aquatic animals such as fishes, turtles, snails, and the like.

Order Rhynchobdellida Family Glossiphoniidae

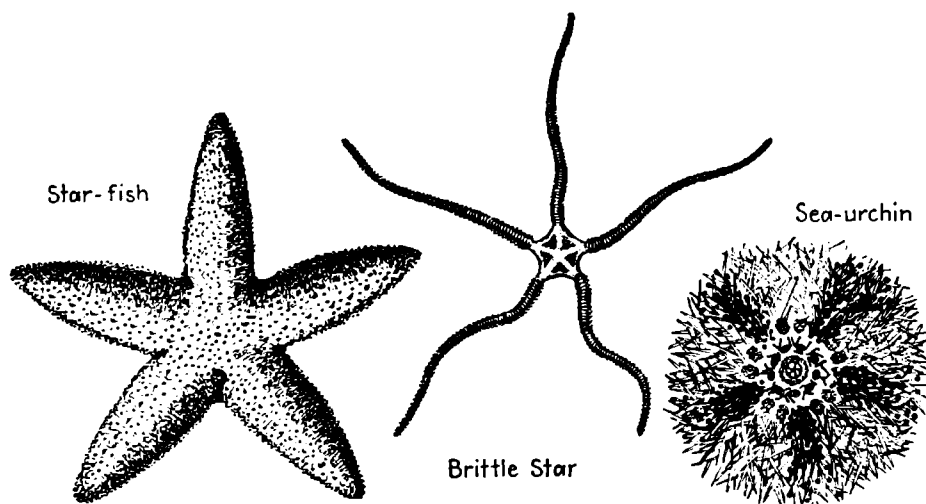
Leech *Placobdella parasitica*

Length to over 2 in. Greenish-black with suckers at each end. Hang on with one end while feeling about with other. Individuals bear both sex organs, the male opening between eleventh and twelfth segments; the female on the twelfth.

Commonest American leech, usually found on turtles, stones, and other submerged objects. May be more active at night in search of animal food, which it locates partly by smelling.

2 individuals mate, eggs of one being fertilized by sperms of other. No cocoon formed in this species, though some make cocoons as do earthworms. Young may remain attached to parent, which they resemble in shape although usually more greenish in color. In species which lay eggs in a cocoon, this is formed on the ninth, tenth, and eleventh segments. European medicinal leech belonging to order Gnathobdellida may be 8 in. long and has been introduced into some streams in eastern United States.

Medicinal leeches were formerly used by physicians for bloodletting. Animals common in temperate zones are pests, which may or may not be serious enemies of living things.



PHYLUM ECHINODERMATA

Nearly 5,000 described species in this group, all marine or brackish water animals. Bodies radially symmetrical, usually 5-rayed. The 5 classes include armed Crinoidea, Asteroidea, and Ophiuroidea, and armless Echinoidea and Halothurioidea. In Crinoidea or sea lilies, mouth opens upward. In Asteroidea or starfish, there is a deep groove along mouth surface, which is lacking in Ophiuroidea or brittle stars. In armless groups, Echinoidea or sea urchins have firm body walls while the Halothurioidea or sea cucumbers have soft body walls.

CLASS ASTEROIDEA

SEA STARS
Order Forcipulata
Family Asteriidae

Starfish *Asterias forbesi*

Usually 5-armed. Width up to 6 in. Greenish-black, with orange plate near base of 2 arms, and red eyespot at end of each arm. Upper surface with coarse spines; lower, with rows of tubular walking feet. Mouth under central disc. Sexes usually distinct. Can right self if placed on back. Sensitive to light, disturbance, or chemical change.

If cut in two, parts may regenerate. Eggs laid in June, hatch into transparent larvae which swim at surface, feed on animals until about $\frac{1}{8}$ in. long, then in a few hours take starfish form and settle to bottom. May reach $2\frac{1}{4}$ in. size in 1 year and breed. Young may eat 50 young clams in 6 days, and large animal may exert $2\frac{1}{2}$ lb. pressure on clam it is attempting to open. May thrust own stomach into clam it can only partly open.

Found from shore to depths of 180 ft., with larger species on northern Pacific coasts. This species ranges from Maine to Mexico, with related species far-flung. One of greatest enemies on beds of oysters and clams, destroying annually millions of dollars' worth of these valuable food animals.

CLASS OPHIUROIDEA

BRITTLE STARS
Order Ophiuræ
Family Ophiodermatidae

Brittle Star *Ophioderma brevispinum*

Central disc 5-sided, thin, about $\frac{1}{2}$ in. across, with 5 slender arms each about $1\frac{1}{2}$ - $2\frac{1}{2}$ in. long extending from corners. Green or brownish-gray. Arms apparently segmented and often broken at tips. Disc rough. Sexes separate. No eyespots evident on arms, but animal retreats from shadow so must be light-sensitive. Lost parts easily restored.

Egg sacs each with 2 openings in pairs on lower sides between arms. Water circulates through egg sacs, possibly to supply oxygen. Eggs freed when fertilized to become free-swimming (pluteus) forms which finally transform into adult form and settle to bottom for rest of life. Closely related basket starfish walks along bottom on tips of branches of arms. About 1,000 species of living brittle stars.

Found from shore to depths of over 700 ft.; particularly in deep water. This species ranges from Cape Cod south, with other brittle stars extending range to Europe, the Pacific Coast, and the tropics. Interesting to collectors because of difficulty of finding a perfect specimen. Dates back to Devonian ancestor.

CLASS ECHINOIDEA

SEA URCHINS
Order Centrechinoidea
Family Arbaciidae (described)
Echinidae (illustrated)

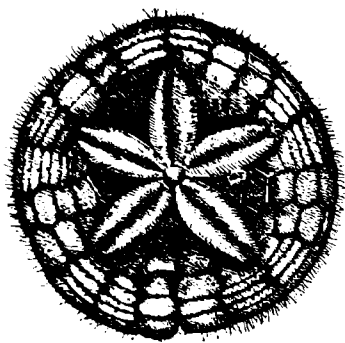
Sea Urchin

Arbacia punctulata (described); *Echinus* sp. (illustrated)

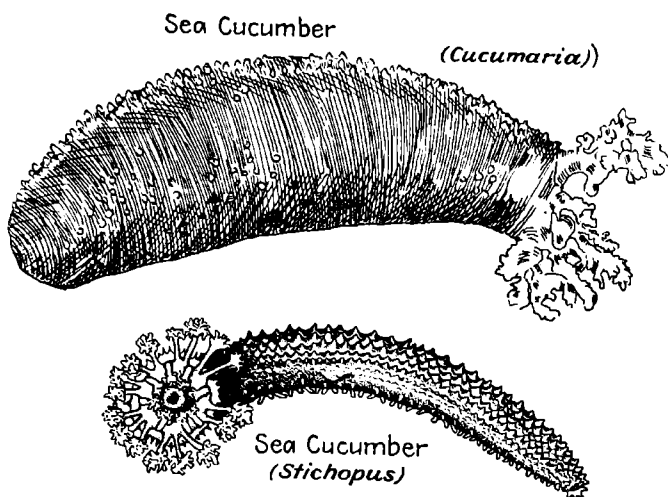
Body up to $1\frac{3}{4}$ in. through, protected by skeleton of lime plates under skin; covered with stout movable $\frac{3}{4}$ -in. spines, usually arranged in 5 broad areas, separated by narrow unprotected areas. Mouth on underside with 5 white teeth. Some species have poisonous spines. 5 double rows of sucker-bearing tube feet.

Eggs number 20 million per individual; expelled from 4 pores near summit of body; developed into clear larvae with reddish spots and 8 rods. Swim for several weeks; then in a few hours change into minute sea urchins which settle to bottom. Strong-toothed mouth grinds animal and vegetable food, even making sand finer by grinding. Teeth and jaws form a flattened sphere shell on beach known as "Aristotle's lantern." Spines usually break off at death.

On sea bottom, from shore to depths of 700 ft.; ranges from Cape Cod to Yucatan, but other species make range world-wide. Internal parts, particularly eggs, used as food by man; Massachusetts market handles 100,000 dozen a year. Animals also produce a dye and provide food for many marine animals.



Sand Dollar



Sea Cucumber

(*Cucumaria*)

Sea Cucumber
(*Stichopus*)

CLASS ECHINOIDEA

Order Exocyclioida Family Scutellidae

Sand Dollar *Echinarachnius parma*

Flattened discs, more or less circular, less than 3 in. in diameter, covered with minute spines and bearing what appears to be a 5-parted flower marking in center. Mouth in center. Purple to gray. On beach, fine spines may be worn away, leaving flat dollar-like thin disc.

Common on Atlantic Coast north of New Jersey and on Pacific Coast south of Puget Sound, with other species extending range widely. Found in sea from tide lines to great depths, but usually on a sandy bottom. Able to recognize whether right side up and can turn over on a sandy but not on a hard bottom. Moving spines resemble waving grain.

Sexes distinct. Eggs and sperms freed into sea water by parents and fertilization takes place independent of them. After free-swimming larval stage, known as the "pluteus," young assume shape of parents, settle to bottom, and continue life there. Intestinal opening in this species is on margin. Sand, bearing food, is taken in with help of spines.

Lack of flesh makes these animals of little importance as food to other animals. Skin and spines ground and mixed with water have been used in making an indelible ink. Fossil species closely resemble living forms, so they have been long-persistent. Hardy and thrive rather well in salt-water aquariums.

PHYLUM ECHINODERMATA

CLASS HOLOTHURIOIDEA. SEA CUMCUMBERS

Order Aspidochirota Family Holothuriidae

Sea Cucumber *Stichopus californicus*

Length to nearly 18 in. Body flat beneath, with 3 rows of black feet; upper surface covered with nipple-like projections, usually in 3 rows. Color reddish-brown. At one end 18-20 tentacles, yellow-tipped and somewhat like flowers on stalks, with mouth in center of this group. In one related species (*S. johnsoni*), feet are red-tipped.

Common along Pacific Coast. Sea cucumbers are found in most seas at various depths, moving over bottom slowly or resting partly buried in sand and mud, or sometimes among rocks. Atlantic Coast genus, found along Florida coast and in West Indies, is *Holothuria*, up to 30 oral tentacles instead of 20 in *Stichopus*.

Sea cucumbers commonly free eggs and sperms into water where eggs become fertilized and, after free-swimming period, larvae settle to bottom and assume adult activities. In some, fertilization takes place within body of mother; in one, young develop within her body and are freed through opening broken in her body wall. In all sexes are distinct. More sensitive than starfish; tentacles show greater ability to select suitable food, which includes plants and animals. Unduly disturbed, a sea cucumber may disgorge most of its internal organs. These can be completely regenerated.

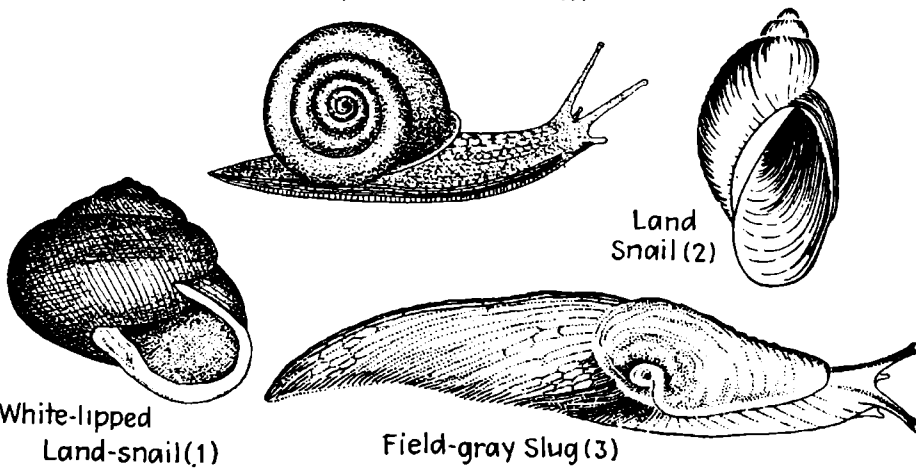
Dried, known as "bêche-de-mer." Used as food by man, being cooked in sea water, dried, then boiled in fresh water or sold as "trepang" to Chinese who use them in making soups. Greatest use as food centers around Malay Peninsula. Cannot be used as substitutes for cucumbers, as their name implies, since they resemble these fruits in shape only. Have a rather thick leathery or rubbery skin which is not easily utilized as food. Animals interesting to zoologists, not only because of unique regenerative ability but because of ability to see, smell, taste, and feel.

Sea Cucumber *Cucumaria frondosa*

In this order, tentacles are irregularly branched like those of a tree. In one genus, *Prolus*, lower surface is flattened, providing a crawling surface. In other genera lower surface is not flattened. In *Cucumaria*, feet are in rows, while in *Thyone* they are scattered over surface. This species is about 10 in. long and 4 in. through.

Common from low-water mark to a depth of 1,200 ft. along Maine coast and in Europe. Reddish-brown above and lighter beneath. Other species and related genera extend range greatly. Some 200 species in family, 75 in genus.

White-lipped Land-snail (1)



PHYLUM MOLLUSCA. CLASS GASTROPODA

Order Pulmonata

Family Polygyridae

1. White-lipped Land Snail *Triodopsis albolabris*

Size to 1¼ in. in diameter. Broader than high, with 5½ low whorls making a low spire. White around lip of opening. Without teeth at opening. Animal varies from cream to gray, black or brown on head. Eyes on ends of the 2 longer "tentacles" on head.

Genus occurs in eastern United States and Canada east of 100th meridian, with subgenus in West. Few related species; common and widely distributed. This species prefers forests of oak, hickory, elm, and walnut and is found among forest debris. See "Fieldbook of Illinois Land Shells," published by Illinois Natural History Survey.

Both sexes represented in 1 individual, though 2 individuals mate reciprocally. Spherical eggs with shells are laid in a moist situation and hatch into small snails difficult to identify because lip and other distinguishing characters are not adequately developed. Eggs laid in May hatch in 20-30 days.

Maturity reached in about 2 years. Animals avoid direct exposure to sun. Feed upon plant material rasped free by tongue. Can detect food by scent. Eyes on long feelers permit seeing over obstructions. Deposit mucous trail. Some land snails are carnivorous. Nature of shell varies with availability of lime.

Essentially scavengers. Preyed on freely by shrews and other animals that often leave caches of them. Some land snails are carriers of flukes and other parasites dangerous to man, but these are limited in their distribution. These parasites may develop further in reptile, bird, or mammal.

Family Succineidae

2. Land Snail *Succinea ovalis*

Length to almost 1 in. in variety *optima*, in which spire is longer than in typical form and shell is yellow or amber rather than green. Shell relatively thick and marked with coarse sculpture. Animal too large to withdraw completely within shell, is blunt before and tapering behind, with 2 short and 2 shorter "feelers."

Shells, commonly known as "amber shells" in this species, found under leaves in forest debris or high on tree trunks, where they may await rainy season before continuing foraging. This species has been found 15 ft. above ground. 1 genus in family, represented in Illinois by 5 species and more races.

Individuals represent both sexes, mating being reciprocal with external organs of both sexes joined in one opening in an individual. Life history probably much like that of white-lipped land snail, with shelled, relatively inconspicuous eggs laid in moist debris. Growth undoubtedly relatively slow.

Animal may vary in color during season, one with a dark body in spring becoming yellowish in summer and fall. Food essentially plant material rasped by tongue. Trail of mucus is left behind as animal moves about. This species favors shady upland wooded areas, while smaller species are commoner in lowlands.

Probably of little direct economic importance though it may be considered as a scavenger and as source of food for some animal eaters such as shrews, moles, some mice, some birds, and other creatures. Tree-climbing habit is found in many beautiful tropical and subtropical snails, many of which have been destroyed by rats introduced as in Hawaii.

Family Limacidae

3. Field Gray Slug *Deroceras agreste*

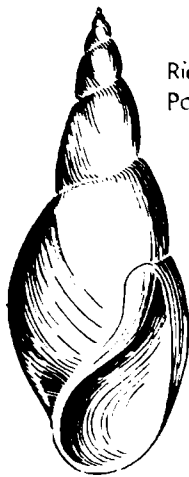
Shell a mere thin plate, white-bordered. Animal with body 1-2 in. long but average about 1½ in., narrow, gray, black, white, yellow, amber, brown and spotted or blotched with irregular black areas. Foot yellowish and with copious milky mucus. Head with 2 pairs of feelers, the longer pair bearing eyes at tips.

Believed introduced from Europe, where it is common, appearing early in last century at Boston, New York, and Philadelphia, but now widely distributed over eastern United States and represented in western part by larger forms. Smaller *D. gracile* lacks white-bordered breathing pore of this species and has prominent tubercles over upper surface of body.

Both sexes in one individual with reciprocal mating. Eggs 500-800 per slug, ¼-½ in. long, white, laid in moist soil among roots, in groups of about 50, hatch in 3 weeks to over winter. Wintering slugs may lay eggs in May that by October may have developed into slugs sufficiently mature to mate and lay eggs or may winter over as adults.

Bad pests in wet seasons in gardens. Fine ashes placed about plants cause animals to secrete mucus to point of exhaustion and death; or poisoned baits of stale beer or Paris green on cabbage or lettuce in protected spots may eliminate individuals. Can detect food by sense of smell and therefore commonly forage at night. Trails of *D. gracile* glisten on sidewalks in morning.

In some areas in wet seasons these slugs may destroy a vegetable garden or ruin the marketability of an otherwise acceptable crop by eating into the center of heads of lettuce or cabbage. Make excellent experimental animals for studying their senses of smell and sight and their resistance to conditions of varying humidity.

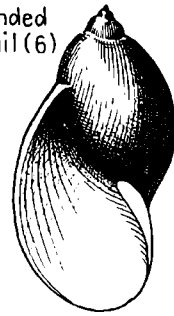


Right-handed
Pond Snail (4)



Disc Pond Snail (5)

Left-handed
Pond Snail (6)



PHYLUM MOLLUSCA. CLASS GASTROPODA

Order Pulmonata

Family Lymnaeidae

4. Right-handed Pond Snail *Sagnicola palustris elodes*

Shell to $1\frac{1}{2}$ in. long and $\frac{1}{2}$ in. through, composed of about 6 whorls in a relatively acute spire, with large opening from which animal protrudes to the right when shell is placed so that point is away from observer. Shell dark, pale brown to black; may vary in thickness in different waters.

Found in stagnant ponds and still fresh waters where lime is abundant or not. Over 200 species in genus, of which 65 are American. This species is circumpolar, being found in Europe and subspecies *elodes* in northern America. Other important species are long-spined *Lymnaea stagnalis jugularis* and fragile *Pseudosuccinea columella*.

Many spherical eggs are laid in clear jelly mass on some support under water, and as young develop they may be observed easily with a hand lens as they twist and turn in their shells within jelly mass. Growth gradual, without conspicuous stages once egg stage and jelly mass has been passed.

Food probably largely plant materials, living or dead, although they have been known to attack living animals. These snails are generally less active than are those of genus *Physella*. Some snails are known to carry disease organisms and much research is being done to improve our understanding in this field.

Animals serve as scavengers, help keep the glass in aquariums clean and provide food for many organisms of food value to man. Some fish live exclusively on mollusks.

Family Planorbidae

5. Disc Pond Snail *Helisoma trivolvis*

Shell a flat coil, to nearly 1 in. wide and to $\frac{3}{8}$ in. high, with coil steadily increasing in diameter and opening relatively wide in mature animal. Usually with about 4 whorls, yellowish or brown, of varying opacity, with an opening that has a sharp lip and V-shaped angle above. Sinistral when young.

Commonest species found in North America east of Rockies. Different species found mostly in temperate North America, where there are some 25 species in all. This species common in streams and muddy-bottomed ponds, commonly among water plants. In related western *H. tenue* of Pacific slope, growth lines are not raised.

Both sexes represented in a single individual, with mating reciprocal between 2 individuals. Eggs laid in small jelly masses, hatch in 2-3 weeks, depending largely on temperature. Stages of development gradual, young differing only in that spire seems to be as in *Physella*.

Not an active pond snail. Food plant and animal matter rasped by mouth and eaten. Animal may serve some function as a scavenger. Can retreat within shell and secure reasonable safety from most enemies, of which there are many. Position in plants gives additional safety.

Not apparently of importance to man, though it may be a reasonably common food for some species of fish that man eats or enjoys catching. Probably host of a number of parasites that may spend other stages in other animals.

Family Physidae

6. Left-handed Pond Snail *Physella heterostropha*

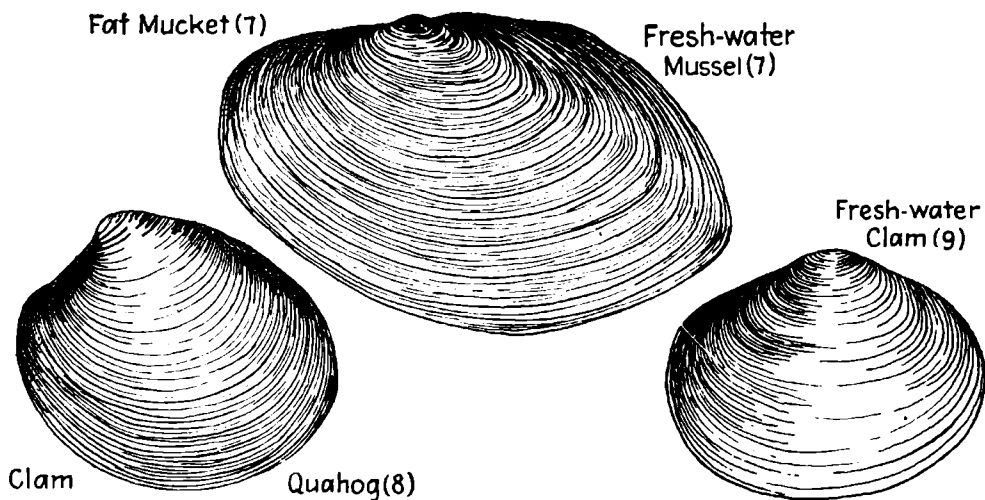
Shell to $\frac{3}{8}$ in. long and to $\frac{1}{4}$ in. through, with opening to the left if point is away from observer; usually 4-whorled, the first being very large and others very small, with an acute tip. Opening about $\frac{3}{4}$ length of whole shell. Yellowish-brown to black. Smoothly gliding, active pond snail.

Very common in stagnant ponds and other still waters. Common in eastern states and perhaps found in Central states, with close relatives extending range throughout the United States. Over 150 species in genus of wide distribution, with some 22 found in United States.

Individuals represent both sexes, though 2 individuals mate reciprocally. Numerous eggs deposited in clear jelly masses on supports of plants or stones under water; hatch in 2-3 weeks. Growth is gradual, this species maturing in about 1 year, though related species may require 2 years to mature.

Food plant and animal matter rasped by tongue and eaten. Active little snails, excellent acrobats of an aquarium, dropping by mucous strings from plants or floating to new grazing grounds in an amazing manner, twisting shell suddenly or exploring with 2 feelers to know their homes better.

Excellent pond and aquarium scavengers and a common food for many fish and other aquatic animals. Possibly a factor in pollution. Filamentous tentacles, foot pointed at rear, single-pieced jaw, are among identification characters.



PHYLUM MOLLUSCA. CLASS PELECYPODA

Order Prionodesmacea

Family Unionidae

7. Fat Mucket, Mussel *Lampsilis siliquoides*

Shells 2, nearly equal, about 2 by 4 in., rounded in front, oval behind. Light or dark green, with eccentric ridges or growth lines around hinged areas as center. Male longer and lighter, female shorter and heavier. A single fleshy spade-shaped foot.

Common in fresh-water lakes, streams, and ponds where water moves little if any and where bottom is well covered with loose mud. Common genera include *Anodonta*, in which hinge lacks the teeth that in other genera align the valves and pivot opening shells; and *Unio*, the type genus.

Many minute eggs that have been fertilized by male become lodged in gills of female and develop there from August-May. Young larvae freed in May attach to bass, develop about 20 days, reaching length of $\frac{1}{100}$ in. only to leave fish and spend about 2 years to reach mature size of 2-3 in.

Scavengers, feeding on organic matter brought into animal with water. Different species of fresh-water mussels or muckets have different fish species on which they are parasitic in larval stage, during which time they are carried considerable distances before beginning independent life. Sensitive.

Harvested by dredging. May contain pearls. Not ordinarily edible. Shells a valuable source of pearl-button material, with best button material from animals dependent on such apparently worthless fish as gars. Collecting controlled by law in some areas. Waste shells of some fertilizer value.

Order Teleodesmacea

Family Veneridae

8. Clam, Quahog, Venus *Mercenaria mercenaria*

Shells two, $5\frac{1}{2}$ by $4\frac{1}{2}$ by 3 in. or thereabouts; dirty white with prominent eccentric ridges on each shell; inner surface of shell dull white, with lower margin purple or violet; shell margin slightly uneven. Hinge with 3 spreading teeth to each valve. Sexes distinct in this species.

Common on sandy and muddy sea bottoms from tide levels to depths of 50 ft. or more, but commonest in shallow bays even in brackish water. On coast, from Nova Scotia to Yucatan, but commonest from Cape Cod to South Carolina with related species extending range considerably.

Numerous small eggs, expelled into water by female, are fertilized at time by male. In about 10 hours, hatch into shell-less, free-swimming stage that lasts about 1 day. Shell-forming stage of 6-12 days follows and animal settles to bottom. Attached until $\frac{1}{2}$ in. long, then burrows. May live about 5 years.

Growth rate about 1 in. a year. Wide muscular foot permits burrowing in mud or in sand. Water carrying food enters through short blunt yellow siphon and leaves through opening nearest shell hinge. Microscopic food collected between gills and forced to mouth by cilia, undesirable material being ejected. Sensitive to disturbance.

This species annually yields hundreds of thousands of dollars worth of food. Shells were used by Indians in making wampum, with blue portion considered the more valuable. Soft-shelled clams (see page 358) may yield twice value of this species. Many people make their living by digging and dredging clams.

Family Sphaeriidae

9. Fresh-water Clam *Sphaerium stamineum*

Shells 2, nearly equal, each about $\frac{1}{2}$ in. long and nearly as broad, relatively thin and weak, shining yellow-brown with rounded eccentric ridges on surface, sometimes apparently translucent but not always so. Sexes distinct but with few superficial differences.

Fairly common in fresh-water streams and ponds, in sand or in mud, or on plants if in a stream. Common in Central states while related smaller *S. striatinum* is common east of Rockies. About 20 American species; 75 in world, with genus widespread over world.

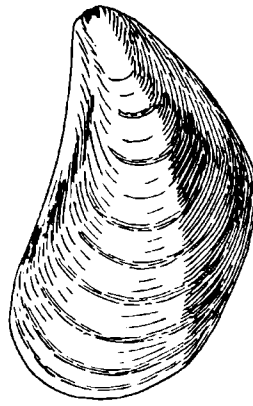
Comparatively few eggs are laid; these are nursed in gills of female. There larvae develop until relatively large and are freed to independence without parasitic stage described for *Lampsilis*. Breeds from April through midsummer. When winter approaches, animal buries self in mud by means of long extensible foot.

May serve somewhat as scavenger and may be of direct importance as food for fish and for other eaters of aquatic animals. Bottom of suitable streams or ponds may be conspicuously white-flecked with empty shells. Nature of shells may vary with availability of lime in surrounding water.

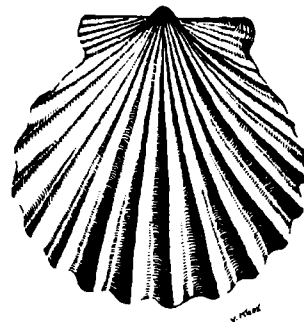
Of little if any direct economic importance to man, though it is a food organism of species that man eats. Interesting because of the nursing of few young in gills of female, in contrast to freeing of many young to a parasitic stage as practiced in muckets.



Oyster (10)



Mussel (11)



Scallop (12)

PHYLUM MOLLUSCA. CLASS PELECYPODA

Order Prionodesmacea

Family Ostreidae

10. Oyster *Ostrea virginica*

Length to 18 in., usually 4-5 inches. 2 shells, the upper usually flat and the lower more convex; attached to bottom by left shell; exposed shell irregular, thick, or in folded layers; inside of shell often blue mixed with white. No foot present in adult. Sexes distinct, or both present in one individual.

From Gulf of Mexico to Gulf of St. Lawrence and introduced on Pacific Coast, where it has become established in some areas. Found in shallow brackish water, commonly on hard bottoms and more commonly near mouths of rivers or bays or for some distance up such arms of ocean. At least 3 species well established.

Females produce about 9 million $\frac{1}{500}$ in. eggs. Fertilized eggs hatch in 5 hours to free-swimming forms. At 32 hours shells appear; in 6 days shells enclose soft parts; in 3 weeks become established as spat and become fixed; growth increases; may be $\frac{1}{4}$ in. across in 10 days, 2 in. in 82 days, sexually mature in 2 years. Sexes indistinguishable externally.

Food, minute plant and animal matter drawn in with water used in breathing; waving hairs on gills cause current. Heart in freshly opened oysters appears as bulb beating close to inner side of great muscle that closes shell. Sensitive to heat, to sound or vibration, to touch and to chemical change, shells closing when animal is irritated.

Important marine animal of annual market value in the millions. Rarely contains pearls. May shelter small soft-bodied oyster crabs, *Pinnotherea ostreum*, males of which are hard-shelled and free-swimming. Sanitary practices demand pollution control where oysters are harvested commercially, and management is essential for a maximum yield under any conditions.

Family Mytilidae

11. Mussel (Marine) *Mytilus edulis*

Length to 4 in. Width to $\frac{1}{3}$ length. Shells about equal, pointed in front, round behind, smooth; violet to dark-brown, pearly within and with violet margins. Attachment, a fibrous byssus belonging to cylindrical grooved foot. Gills, rows of filamentous structures.

Widely distributed, generally north of San Francisco on our Pacific Coast and of North Carolina on our Atlantic Coast; common in European waters. In sand or mud, attached to rock or to each other between tide lines or in shallow salty or brackish waters. Several hundred species in family, varying in size, color, and edibility.

Sexes distinct; sex glands distributed through animal. Tiny yellowish eggs found almost anywhere, as in foot, gills, or other parts. A California species may lay to 100,000 eggs a year, these developing within year to animals to $3\frac{1}{2}$ in. long. Become attached early by network of strong byssus threads and resist wave action easily.

May move about at will by means of glue-like threads it puts out. Often mantle tip protrudes from separated shells. This attracts fish that may come too close and be captured by closing shells, as shells snap quickly when animal is disturbed. Sensitive to touch and to salinity. Protection is by burrowing, by exposed nature of habitats, and by shells.

Species in common use in France for food, there cultivated and harvested for profit. Also sold in markets on east and west coasts of America, but used more in chowder. Has unique color when cooked. Since it thrives in polluted water, its abundance may be a snare and a delusion. Animals unable to close shells should always be avoided as food for man.

Family Pectinidae

12. Scallop *Pecten irradians*

Shells 2, one flatter than the other, with a straight hinge, without teeth; about 20 radiating, conspicuous ribs on shell and abundant lines of growth; up to 1 ft. across but commonly much smaller. Edges of mantle may protrude from shell, exposing 30-40 bright blue eyes that may glow. Between eyes are delicate feelers sensitive to disturbance. Color varies from white, orange, purplish to brownish with several conspicuous radiating orange bands.

Found from Nova Scotia to Texas. Common pecten of Atlantic Coast, abundant on eastern Long Island Sound, in shallow water of salt-water bays where bottom is covered with sand or seaweed, on mud flats, or even in water hundreds of feet deep. Closely related species make distribution worldwide. Some 11,000 living and some 15,000 fossil pelecypods.

Breeds in early summer and grows so rapidly that by winter young may reach a length of 1 in. After a free-swimming stage that develops from fertilized egg, animals attach by secreted stems to submerged support and develop to width of $1\frac{1}{2}$ in.; then change to free roaming life with usual life span in the neighborhood of 4 years.

Adults move in zigzags by flapping shells, much as butterflies move with wings. A shell flap is accompanied by a jet of water and may move animal several feet. Has definite seasonal migration and is somewhat gregarious. Food, minute living things taken in with water used in breathing. Sufficiently sensitive to take to flight with a passing shadow.

Basis of industry of several hundred thousand dollars in the East. Animals captured by dredging but abundance varies greatly. Muscles are eaten most commonly but other parts are also edible. Shell is used in many art designs and in the Middle Ages one species had religious significance. Shell is now the trade-mark of an important oil company.

PHYLUM MOLLUSCA.

Order Prionodesmacea Family Arcidae

Comb-like teeth, in rows on hinge. Foot, large. Mantle edges with row of eyes. Shells relatively heavy with thick velvety or hairy covering or epidermis, which wears off variously in dead shells.

13. Black, Widow, or Ponderous Ark. *Noetia ponderosa*
Length, 2½ in. Heavy, swollen, with about 32 flattened radiating ribs; yellowish-white with dark shaggy covering. Interior yellowish-white, but white and glossy at edge. Massachusetts to Texas. Abundant in South.

14. Ark Shell. *Anadara campechiensis*
Largest at Cape Cod. Length to 2 in. Left valve ridges, flatter and narrower. Massachusetts to Texas. Variety *pexata*, "bloody clam," Massachusetts to North Carolina.

15. Ark Shell. *Anadara transversa*
Length 1½-2 in. Width about same. Height, ¾ length. Brown. Ribs, about 35, deeply cut. Shallow water, Massachusetts to Texas, especially on Nantucket and west coast of Florida.

Family Ostreidae (See p. 355) Family Pectinidae

Mantle hangs like finely fringed curtain inside each shell, with conspicuous row of black eye dots along its base. (See p. 355.) Notch under ear of shell marks opening through which byssus attachment may be spun.

12. Scallop. *Pecten irradians* (See p. 355)

16. Pink Scallop. *Pecten hercicus*
Length to 2½ in. Pink. With unequal ears. Thin ribs bearing slender spines. Under valve, white; upper, pink-banded, with fewer ribs. Deep water. Port Althorp, Alaska, to San Diego, Calif. Off San Juan Island, Wash., at depths of 150-200 ft.

17. Pacific Scallop. *Pecten circularis aequisulcatus*
Length to 3 in. Typical form, round scallop, with bulging shell. Variety is equally grooved scallop. Deep water, or at shore line at low tide, lying on right side or attempting to escape. While whole soft parts are edible, only adductor muscle is sold and darker parts are rejected. From Santa Barbara to Cape San Lucas in Lower California. Dredged commercially at Anaheim, Calif.

18. Purple-hinged or Rock Scallop. *Hinnites giganteus*
Diameter to nearly 2 in. Height to 4 in. Length to 6 in. Free-swimming when young, with shells nearly alike. With age, becomes attached by one shell that conforms to rock. Near hinge inside always deep purple. Disturbed, an adult may clap its shell, forcing water stream several feet into air. Not abundant enough to be of commercial importance, nor is it easily taken. From Aleutian Islands to Magdalena Bay in Lower California.

Family Anomiidae

Left or lower shell pierced; animal attaches firmly through hole to some object; fixed shells lose locomotion muscle. Upper shells convex. Both shells let light through easily and are thin and pearly.

19. Plain Jingle Shell. *Anomia simplex*
Diameter 1-2 in. Largest of genus on Atlantic Coast. Oval or circular but variable, fitting self to object of attachment. When fixed, may bore foot into cover. Outer surface dark, fragile; when worn, dead shells show golden or greenish mother-of-pearl. Shallow water, particularly on oyster beds. Nova Scotia to West Indies.

20. Rock Oyster, Jingle Shell, Pearly Monia. *Pododesmus macrochisma*
Length to 4 in. Attached, one shell much smaller than other, with hole through which muscle scar is visible.

CLASS PELECYPODA

Rough outside but pearly inside, with purple and green tints. Flesh bright orange, edible, commercially important. From Pribilof Islands to Sea of Okhotsk and Lower California. At Puget Sound, at 100-250 ft. down.

Family Mytilidae

Commonly between tide lines, attached separately, grouped in nests or sunk in burrows in wood or earth. 2 shells equal and generally long.

11. Mussel. *Mytilus edulis* (See p. 355)

21. Hooked Mussel. *Mytilus recurvus* (*M. hamatus*)
Length 1-2 in. Shell thick, dark-colored; surface densely striped. Rhode Island to Texas and West Indies. Particularly abundant in Florida.

22. Humble Mussel. *Volzella demissa plicata*
Length 2-4 in. Narrow, yellow-green, triangular, fat, dingy-looking, brittle, compressed behind, plaited and with finely radiating lines or ribs, apparently varnished. Lining silvery white. Attachment long and strong. Makes nests of shells or burrows. Probably commonest eastern mussel. In tide waters or mud flats at stream mouths, usually near high-water mark. Often among reeds in burrows in banks. Being common and at its best in polluted waters, it should not be eaten. From Nova Scotia to Georgia. Smaller in northern range.

23. Straight Horse Mussel. *Volzella recta*
Length to 4 in. Brown rather than black, either conspicuously bearded or ridged. Umbo not at extreme end. Usually solitary, attached, partly buried in mud or gravel. Edible but not commercially important. From Bolinas Bay, Calif. to Magdalena Bay, Lower California.

24. Hooked Pea-pod Shell. *Botula falcata*
Length to 3 in. Shell thin, flexible, pearly white inside, dark chestnut outside, with conspicuous transverse wrinkles. Bores holes in solid rock and attaches with strong byssus. More common in sheltered shallow water than on exposed wave-beaten rocks. From Coos Bay, Ore., to San Diego, Calif.

Order Anomalodesmacea Family Pandoridae

Shells pearly, irregular, thin, usually with right shell flat and mate convex. 2 spreading teeth in right shell form grooves for tooth in left.

25. Pandora. *Pandora gouldiana*
Length to 1½ in. Height ¾ in. Width ½ in. Delicate clear white, rough, very thin with iridescent interior. In oyster beds, in sand or mud, burrowing freely. Common to depth of 180 ft., from Prince Edward Island to North Carolina.

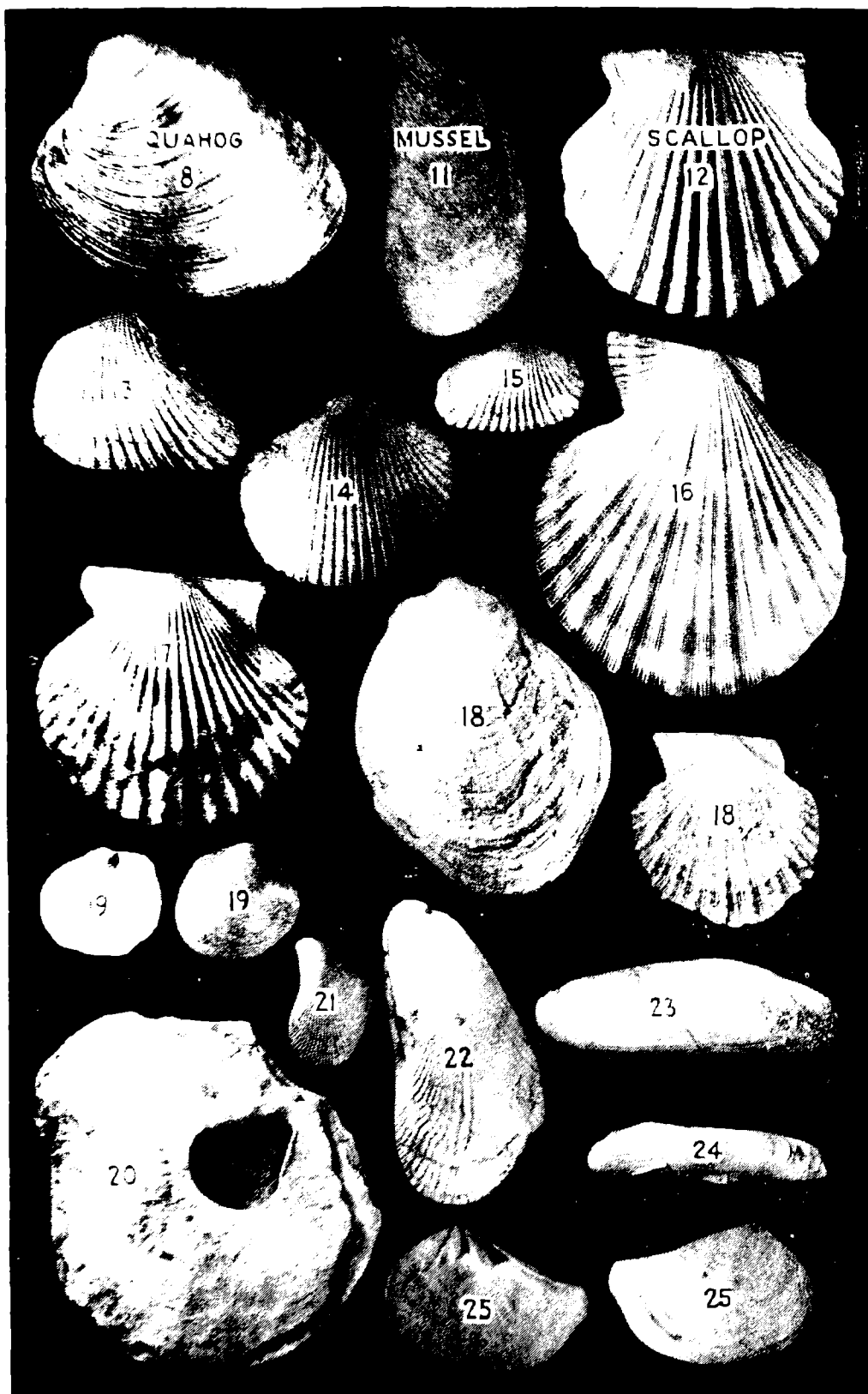
Order Teleodesmacea Family Chamidae

26. Agate Chama, Rock Oyster. *Chama pellucida*
Length to 2 in. Outside irregular, rough, frilled, hard, translucent, white, rosy or otherwise. Inside lined with opaque white layer frilled at margin. Living shells usually too firmly attached to be removed entire. Looks like nubbin of rock or like limpet. Young formerly considered separate species. On pilings and breakwater rocks from Oregon to Chile and Galapagos Islands.

Family Cardiidae

Shell margins conspicuously toothed.

27. Heart Shell, Basket Cockle. *Clinocardium nuttallii* (*Cardium corbis*)
Length to 4 in. Shell brittle, easily broken, conspicuously grooved outside, white inside. Active. Makes shallow burrow with long strong foot. No long siphon tube. Edible but not commercially important. Bering Sea to Japan and San Diego, on tide flats. Common West Coast species.



PHYLUM MOLLUSCA. CLASS PELECYPODA

Order Teleodermacea Family Cardiidae

28. Morton Cockle, Duck Clam. *Laevicardium mortoni*
Length to 1 in. Width about same. Height $\frac{3}{4}$ length. Shell thin, small, smooth. Pale fawn color, sometimes with brown spots on outside and bright yellow with purple blotch within. Often brilliant in muddy water, but color fades. Shallow waters (to 30 ft.) on sand flats. Nova Scotia to Gulf of Mexico. Common south of Cape Cod. A small cockle.

29. Great Cockle. *Dinocardium robustum*
Length to 4 in. Height to $5\frac{1}{4}$ in. Heart-shaped. Posterior somewhat flattened. With 35-37 regularly arranged broad radiating ribs and crenulated margins. Yellow-brown with irregular rows of chestnut or purple spots. A most conspicuous Florida beach shell. Found from Cape May to Florida, Gulf of Mexico to British Honduras and Central America.

Family Veneridae

Shell valves equal and strong. Foot, strong. Of variable beauty but of wide distribution.

30. Elegant Dosinia. *Dosinia elegans*
Flat, almost disc-like. Length to $2\frac{1}{2}$ in. Surface distinctly marked with concentric raised ridges. Prefers warm offshore waters. Sometimes abundant. Cape Hatteras to Yucatan and in West Indies.

31. Hard-shelled Clam. *Pitar morrhuana*
Length to 2 in. Shell plump, thin but hard, chalky, with concentric scratches. Prince Edward Island to Cape Hatteras.

32. Spotted Callista. *Macrocallista maculata*
Length to 3 in. Beautiful. Surface marked with violet-brown patches or waves and a shining horny skin. Inside white. Flesh edible but peppery. In Florida, dates from Pliocene times. Not too common. From Cape Hatteras to Gulf of Mexico, West Indies, and on to Brazil.

33. White Amiantis, Sea Cockle. *Amiantis callosa*
Length to 4 in. Pure white. Edges thin. No ribs, but many often paired concentric ridges. Less triangular than Pismo clam. Beaches at extremely low tide. Edible but not commercially important. From Santa Monica, Calif. to Gulf of Tehuantepec.

34. Pismo Clam. *Tivela stultorum*
Length to 7 in. Weight to 4 lb. 3 oz. Not legal to take those under $4\frac{3}{4}$ in. across, which weigh about $1\frac{1}{4}$ lb. Shell apparently varnished, pale brown, often with faint concentric purplish markings. Foot short and like a plow-share. Spawns from July to September and young are free-swimming for a short time. Takes 7-11 years to reach legal size. Individuals known to have lived 25 years. Only on open surf-beaten sandy beaches, almost invariably above low-water mark. Second only to abalone in weight of crop harvested in California, but rivaled by introduced soft-shelled clam. Half moon Bay, Calif., to Socorro Island, Mex.

35. Cross-barred Venus. *Chione cancellata*
Length to $1\frac{1}{2}$ in. Heart-shaped to triangular but with narrow raised ridges crossing on surface. Dirty white to yellow-brown outside; inside white, violet, purple, or orange. Commonest Venus-like Florida shell. From Cape Hatteras to Florida and West Indies.

8. Venus Clam, Quahog. *Mercenaria mercenaria* (See p. 354)

36. Ribbed Rock Venus, Hard-shelled Clam, Little-neck Clam. *Protothaca staminea*
Length rarely over 3 in. Valves so deeply arched as to make animal appear round. Longer than true cockle. Foot flattened, strong but not long. In bays and gravel but not in mud. Edible. Of some commercial importance. Commander and Aleutian Islands, to Kamchatka and Japan and to Puget Sound and Socorro Island, Mex.

37. Rock Cockle. *Protothaca laciniata*
Shell covered with radiating ribs, crossed by concentric ribs of equal prominence and often with small spines at the intersections. From Unalaska, Alaska, to San Diego, Calif.

CLASS PELECYPODA

38. Butter Clam, Nuttall's Saxodomus, Money Shell *Saxodomus nuttalli*
Length to 5 in. Shells with rough eccentric ridges; when young, with brown markings on beaks and purple trace inside. Name money shell refers to use of shells as money by Indians. Delicious. Found between tide marks in sand and gravel. Humboldt Bay to San Diego, and a close relative, the giant saxodomus or Washington clam, from Aleutian Islands to Monterey Bay.

39. Thin Copper Shell. *Compsomyx subdiaphana*
Length to 2 in. Shell thin, white, glistening, apparently swollen. From Sannak Island, Alaska to San Diego, Calif.

40. Gem Shell. *Gemma gemma*
Like small yellow peas, to $\frac{1}{8}$ in. through and about $\frac{1}{2}$ as wide. Pink, yellow, white, or violet-tinged or colorless. Surface smooth and shining. In sand, between tide marks or in shallow water. Often abundant. From Labrador to North Carolina. Young carried a long time by parent and when freed active and independent.

Family Petricolidae

41. Heart-shaped Rock Dweller. *Petricola carditoides*
Length to 2 in. Dingy white, oval, with radiating ribs. Variable, from long and narrow to flat and oval. Bores into soft rock, shell conforming to shape of hole. On sandy and muddy beaches. From Vancouver Island to Magdalena Bay, Lower California.

Family Tellinidae

42. Bodega Tellen. *Tellina bodegensis*
Length to 2 in. Shell creamy white with polished surface etched with fine concentric lines. Found on outer sandy beaches. Strong, active. Edible but not commercially abundant. From Queen Charlotte Islands off British Columbia to Gulf of California.

43. Bent-nosed Macoma. *Macoma nasuta*
Length to $2\frac{1}{2}$ in. Whitish or brown stained with mud. Shells light, thin-edged. Siphons long, indicating deep-burrowing habit. In mud in sheltered bays or on sand beaches. Survives brackish water well. Common in Indian midden heaps. Popular in Chinese market in San Francisco. Kodiak Island and Cook's Inlet, Alaska to Scammon Lagoon, Lower California.

Family Donacidae

Wedge-shaped shells of clean sandy ocean beaches. Foot, long. Gills, variable. Mantle, open, fringed.

44. Wedge or Pompano Shell, Coquina. *Donax variabilis*
Length to 1 in. Beautiful blue-white with purple or reddish bands. Variable in color and pattern. Common on clean sand beaches. Buries self rapidly. In spring tossed alive on beach in great numbers. Excellent soup base. Shells made into "birds" and "flowers." Commonest East Coast wedge shell. From Cape Hatteras to Texas and in West Indies.

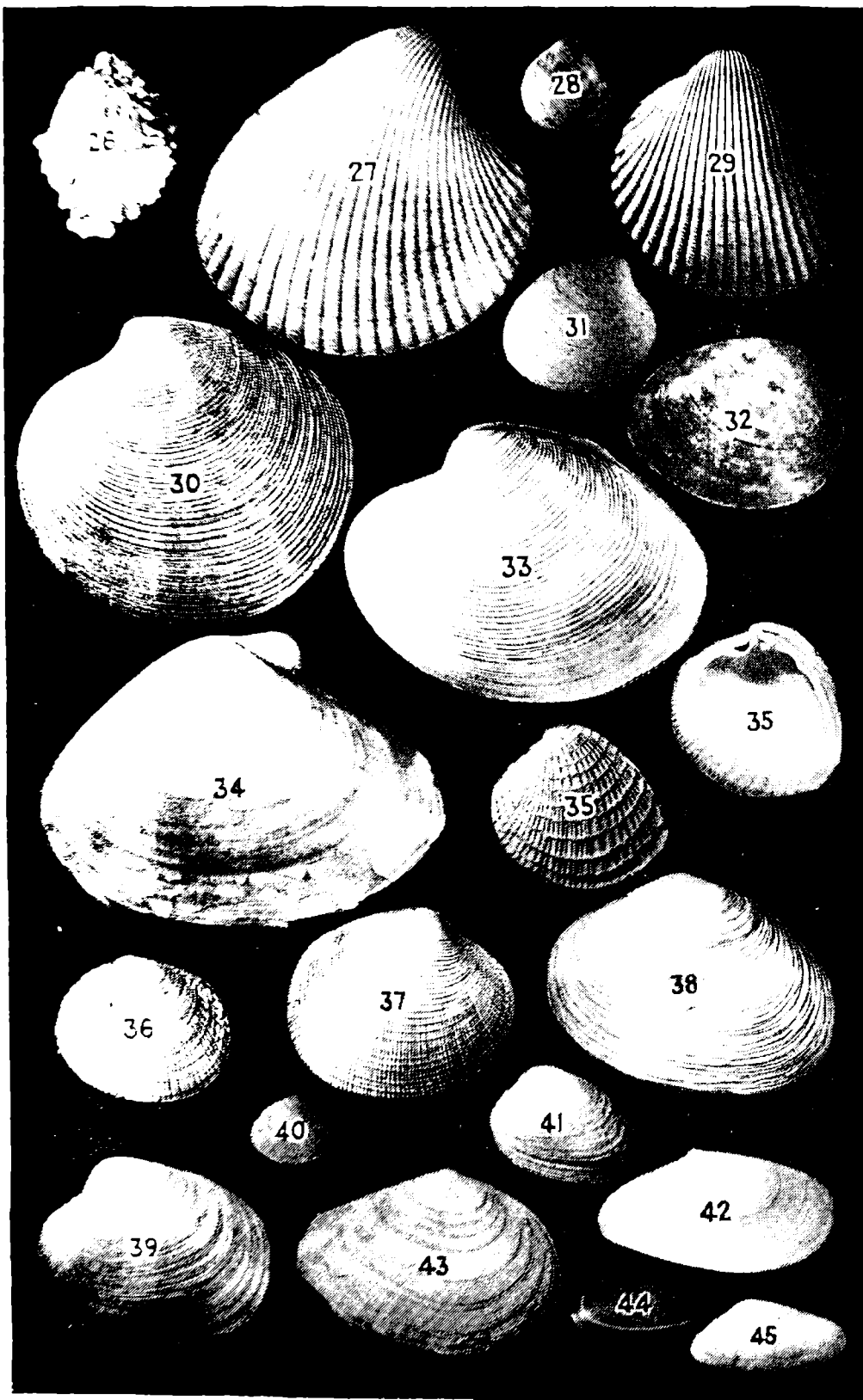
45. Wedge Shell. *Donax californica*
Length under 1 in. Shell attractive, light, thin and like related Gould's wedge shell often well-colored. Just beneath sand surface. Good for soups. San Pedro, Calif., to Panama.

Family Diplodontiidae

46. Round Diplodonta. *Diplodonta orbella*
Length about 1 in. Shell white often hidden by cemented sand. Bering Sea to Gulf of California.

47. Short Razor Clam. *Tagelus gibbus*
Length to 4 in. Height $\frac{1}{2}$ length. Width $\frac{1}{4}$ length. Shell thick, almost cylindrical. Foot large, retractile into shells. Siphons 2 tubes, each longer than shell; each may maintain separate hole through sand, giving burrow 2 exits. Cape Cod to Florida and Texas.

48. California Razor Clam, Jackknife Clam. *Tagelus californianus*
Length to over 4 in. Shell thin, gray, dull. Lives in vertical burrow in soft sandy mud. Favored food of ducks and eaten by human beings. Sold as bait but not commercially important. Monterey to Gulf of Tehuantepec.



PHYLUM MOLLUSCA. CLASS PELECYPODA

Order Teleodermacea

Family Solenidae

Valves of shell gape at each end and much elongated.

49. Sword Razor Clam. *Ensis directus*

Length to 6 in. Width $\frac{1}{2}$ length. Yellow or green. Right shell with 1 projecting tooth and long ridge-like tooth back of it. Left shell with 2 teeth and double ridge. Burrows rapidly in sand at low-water mark by digging motion of club-shaped foot. Animal larger than thin shell. Gulf of St. Lawrence to Florida.

50. Sea Clam, Razor Shell. *Siliqua patula*

Length to 6 in. Shell thin, brittle, smooth inside and out. White outside, zoned with violet; inside tinted either with pink or violet. Animal too big for shell. Moves rapidly through sand and can bury self in 6 seconds. Disturbed, it may squirt water high in air. Delicious. Favorite in South where sufficiently abundant to have commercial importance. Canned in Alaska and in Washington. Arctic Ocean to Pismo, Calif.

Family Mactridae

Shells with heavy thick skin. Siphons united and fringed. Foot flattened. Mantle open in front.

51. Surf, Giant, or Hen Clam. *Spisula solidissima*

Length to 7 in. Height $\frac{1}{2}$ length. Width $\frac{3}{4}$ length. Shell large, solid, brown or white. Largest Atlantic Coast bivalve. Can leap a foot in escape. May be caught by thrusting stick between open valves. Excellent food. Caught in shallow water. Labrador to North Carolina. Variety *similis* from Massachusetts to Gulf of Mexico, most abundant south of Cape Hatteras.

52. Triangular Clam. *Mulinia lateralis*

Length to $\frac{3}{4}$ in. Height to $\frac{1}{2}$ in. Width $\frac{3}{4}$ in. Whitish, triangular, apparently smooth but really wrinkled. Smoother in South. Bare, white, with brownish skin. Muddy bottoms, near river mouths. Often abundant, particularly in Long Island Sound. New Brunswick to Texas and West Indies.

53. Washington Clam, Summer Clam, Otter Shell

Schizothaerus nuttallii

Length to 8 in. Weight to 4 lb. Shell thin, easily broken, not including all of animal. Foot small. Siphons long and stout. Shell may lie buried 3 ft. deep usually below mid-tide. May squirt water 3 ft. high when disturbed. Siphons tough, but flesh is delicious. Indians dried siphons for later use in soups and chowders. Called "geoduck" but this name should correctly be applied to *Panope generosa* of family Saxicavidae. Typical form ranges from Bolinas, Calif., to Scammon's Lagoon, Lower California; variety *capax* from Kodiak Island to Monterey, Calif.

Family Myacidae

Soft-shelled clams. One shell has spoon-shaped tooth that fits into corresponding opening in other.

54. Sand or Soft-shelled Clam, Nannynose. *Mya arenaria*

Length to about 4 in. Width over $\frac{1}{2}$ length. Open at each end. Shell chalky white with brownish cover. Skin wrinkled, thin, dirty brown. Common between tide lines, in shallow water and mud flats. Burrows to 1-ft. depth, leaving small opening through which water squirts. European. Greenland to Cape Hatteras. Victoria, B. C., to Monterey, Calif. In 1935 on East Coast, 11,635,000 lb. sold for \$704,000.

55. California Soft-shelled Clam. *Cryptomya californica*

Length about 1 in. Shell white, thin, almost smooth, slightly ashy, and slightly gaping. Chichagof Island, Alaska, to Topolobampo, Mex.

56. Checkered Soft-shelled Clam

Platydora cancellatus

Length to 3 in. White, gray, ashy, with greatly bulged valves. Surface with fine, irregular growth lines overlaid with brownish-gray cover. Near bay entrances where current is brisk. Burrows into firm hard clay but not in rock or shifting sands or mud. Edible but not commercially important. Queen Charlotte Island to San Diego, Calif.

Family Pholadidae

Shells gape at both ends, with tooth-like sculptures in front and no hinge or ligament.

57. Angel's Wing Shell. *Barnea costata*

Length to 8 in. Width and height each about $\frac{1}{2}$ length. Shell white. Animal yellow. Shells meet only near tips. Burrow in colonies down several feet in sandy mud or clay, or in wood or rocks. Massachusetts to the West Indies. Commonly sold for food in Cuba.

58. Little Piddock. *Martesia cuneiformis*

Shell small. Length to $\frac{3}{4}$ in. Height to $\frac{3}{4}$ in. Closed and divided by oblique serrated canal. May burrow into timber or soft rock. Connecticut to Trinidad.

59. California Piddock. *Parapholas californica*

Length to 5 in. Upper end of shell with scales. Shells white, delicate. Burrows into hard clay, using waste to build stout, cone-like channel to protect siphons that reach up to open water. Edible but not commercially important. Southern Oregon to San Diego, Calif.

Family Saxicavidae

60. Geoduck, Giant Panope. *Panope generosa*

Largest of burrowing clams; shells to 7 in. long, partly enclosing soft animal that may weigh 6½ lb. Huge siphons cannot be pulled inside shell; latter white, with conspicuous growth lines. Each valve has a prominent tooth. Considered a delicacy. Ranges from Forrester Island, Alaska, to Scammon's Lagoon, Lower California. Common name geoduck pronounced "goey duck."

CLASS SCAPHOPODA

Family Dentaliidae

Shells and animals suggest both pelecypods and gastropods. Like pelecypods, they lack true head and are bilaterally symmetric. Like gastropods, they have a single shell. Some are to 5 in. long.

61. Tooth, Tusk, or Precious Tusk Shell. *Dentalium pretiosum*

Shells resemble small slightly curved hollow delicate white teeth or tusks; to 1 in. or more long; larger open end is the lower, from which animal extends foot in digging sand; from smaller upper end extend tentacles that capture food. Indians used shells for money and made them into beads. Live mostly in sand. Collected by comb-like dredges. From Forrester Island, Alaska, to San Diego, Calif.

CLASS GASTROPODA

Gastropods have a single shell, commonly coiled but sometimes greatly reduced, with an opening, the aperture, that may be closed by an operculum. Muscular foot may be drawn into protection of shell. Eyes may be present either on tentacles or at their bases. Food rasped with long file-like tongue that may be extended greatly. They may breathe by lungs or by gills, and may hear by means of special organs on foot. React variously to light. May locate food by smell.

Order Prosobranchiata

Family Acmaeidae

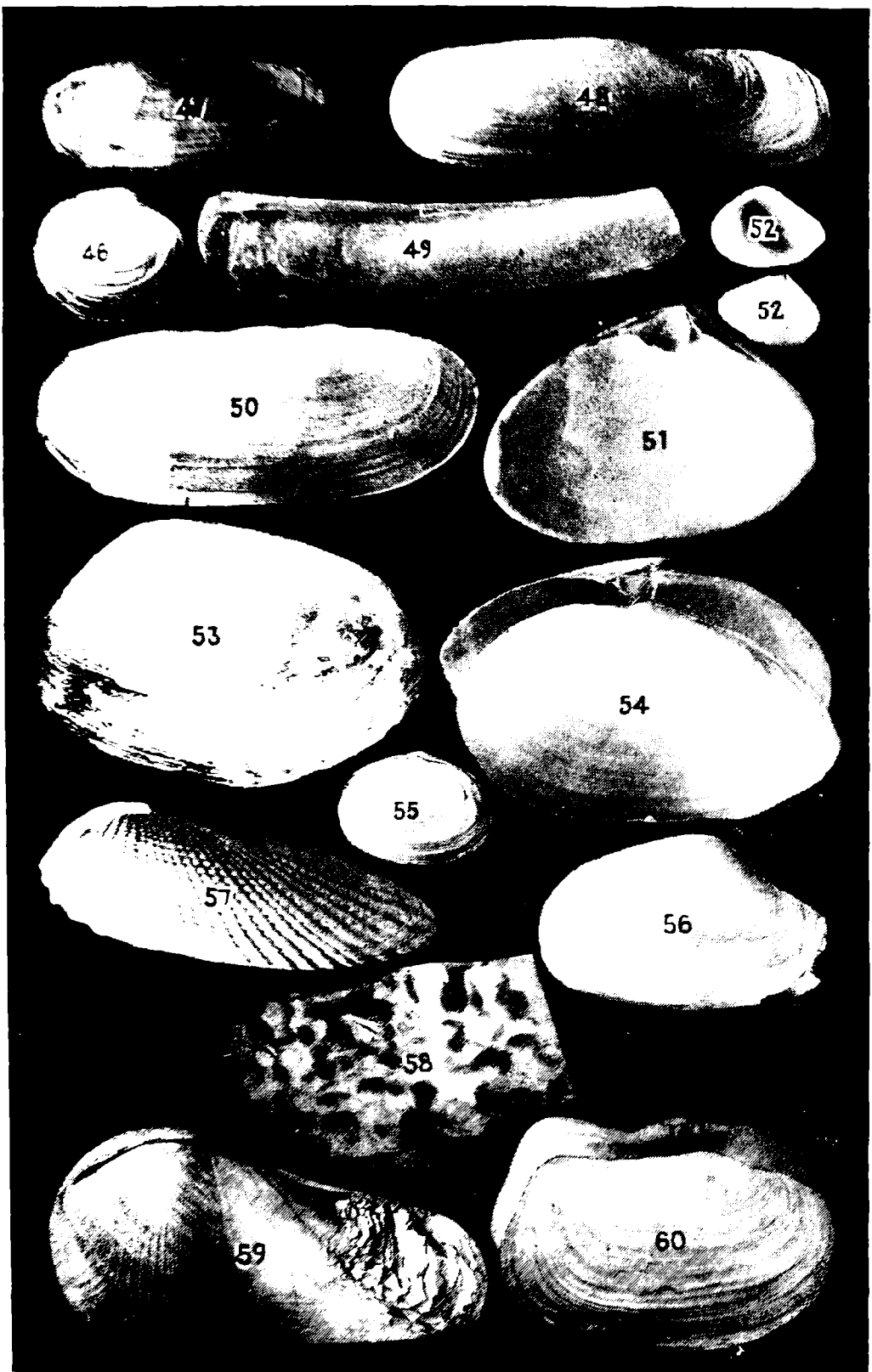
62. White-cap Limpet. *Acmaea mitra*

Length about 1 in. Shell like a small cone or tent, with smooth white surface. Animal may move, but when disturbed clamps firmly to support and can hardly be removed with knife. Knife thrust quickly under before disturbance frees animal easily. Eaten by man. More commonly used as fish bait. Shells used as earrings. Pribilof Islands and Bering Sea to San Diego, Calif.

Family Haliotidae

63. Blue Abalone. *Haliotis fulgens*

Length to nearly 1 ft. Width $\frac{3}{4}$ length. Spiral almost obscure. Shell like broad shallow bowl with row of small oval holes along one side. Outside rough, coarse, frequently covered with other organisms. Inside layer of mother-of-pearl or nacre rich in rainbow tints, and glistening. Animal remains attached to rock, breathing through holes. New holes appear with age and old ones fill. Flesh has high commercial value. California has harvested over 700 tons a year, exceeding by weight 3 times the combined harvest of Pismo clams, soft-shelled clams, sea mussels, cockles, Washington clams, and bay mussels. Small animals protected by law. Found from Farallone and Catalina Island, Calif., to Gulf of California, Mex.



PHYLUM MOLLUSCA.

Order Prosobranchiata Family Fissurellidae

64. Rough Keyhole Limpet. *Diodora aspera*

Length to over 2 in. but usually smaller. Conical, with elliptical base and with ridges radiating from hole at crest of cone. Outside dark-purple to gray-brown. Inside pearly white. Cling to rocks. Cook's Inlet, Alaska, to Magdalena Bay, Lower California.

Family Trochidae

65. Puppet Margarites. *Margarites pupillus*

Length about $\frac{1}{2}$ in. Yellow-brown. Whorls 4, plainly marked with spiral ridges. Openings nearly circular. Nunivak Island in Bering Sea, to San Pedro, Calif., where it is found in deep water.

66. Black Top Shell. *Tegula funebris*

Length to just over 1 in. Purple to black outside. Greenish-white and pearly as outer layers wear or break. Normally 4 whorls, with upper often worn off or broken. May carpet rocks exposed to violent wave action. Eaten freely by fish. Vancouver Island, B. C., to Cerros Island, Lower California.

Family Trochidae

67. Ringed Top Shell. *Calliostoma annulatum*

Length to about 1 in. Beautifully and finely engraved pointed cone, with spiral grooves usually marked in deep purple. Edge of lip fine and thin. Live on seaweeds in deep water. On bright days may be near surface. Forrester Island, Alaska, to Catalina Island, Calif.

Family Turbinidae

68. Wavy Turbine Shell. *Astraea undosa*

Length to 4 in. Covered with brown fibrous skin. Whorls wrinkled and ornamented. Operculum horny within. Vegetarian. Laguna Beach, Calif., to Cerros Island, Lower California.

Family Epitoniidae

69. Angular Wentletrap, Angled Staircase Shell. *Epitonium angulatum*

Length to $\frac{3}{4}$ in. With 6-11 whorls, there being 9 ribs to each whorl. Mouth opening almost circular. Many pure white. Longitudinal ribs represent periods of rest or slow growth. Give off purple fluid when disturbed. Prey on other animals. Eat beef hungrily. Connecticut to Texas.

Family Naticidae

70. Little Moon Shell. *Natica canrena*

Length about 1 in. Brown with longitudinal zigzag streaks. About 5 whorls, smooth and regular, with limy operculum. No eyes. Has huge foot that envelops food. Prey is another shellfish. Soft parts eaten out after a hole has been drilled through shell. May eat dead fish and act as scavenger. Often found in sand, burrowing for bivalves. Common from North Carolina to West Indies.

71. Moon Shell, Sand Collar. *Polinices duplicatus*

Length about 2 in. Width same. Shell solid, with 5 or more whorls and a prominent spire. Opening oval and oblique. Horny operculum partly closes opening in shell. Lip thin, sharp. Interior pearly or chestnut. Outside ashy-gray to brown. Found in shallow waters. Massachusetts Bay to Gulf of Mexico.

72. Lewis's Bull's-eye. *Polinices lewisii*

Sometimes to 6 in. through. More normally 3-4 in. Yellowish-white, smooth-surfaced, with rather large aperture closed by broad horny operculum. Strictly carnivorous, preying on other shelled animals through whose shells a hole is drilled, permitting access to soft flesh inside. Unusually large foot. Moves freely in search of food. Duncan Bay, B. C., to Santa Barbara Islands, Calif.

Family Crepidulidae

Shells have shelf on inside of one half.

73. Flat Slipper Shell. *Crepidula plana*

Length to $1\frac{1}{2}$ in. Width just over $\frac{1}{2}$ in. Shell frail, flat with white polished interior and milky white outside, frequently curved to conform to shape of support. Female reported to be 15 times size of male. Common in all warm

CLASS GASTROPOPODA

seas, often attached to shells or seaweeds from low-water mark to depth of 3,000 ft. Prince Edward Island to Texas.

74. Arched Slipper Shell, Quarter-deck, Boat Shell *Crepidula fornicata*

Length to 2 in. Brown or white. Obliquely oval, with a white strong solid diaphragm. Eats seaweed or other mollusks. Found attached to shells of other animals. Has commercial value as base for oyster beds. Common in shallow water. Prince Edward Island to Texas and West Indies. Also in Europe.

75. Hooked Slipper Shell. *Crepidula adunca*

Length to $\frac{3}{4}$ in. Shaped like slipper or small boat, but recurved at tip. Surface brown. "Deck" white. In young animals point at end is sharp and less curved. Vancouver Island, B. C., to Cape San Lucas, Lower California.

Family Littorinidae

Shell spiralled, more or less globular or top-shaped, with round opening and horny operculum or opening cover. Widely distributed.

76. Periwinkle. *Littorina littorea*

Length up to 1 in. Width $\frac{3}{4}$ length. Shell solid, roughened, yellow, black, brown, or red, with dark bands and somewhat glossy. Inside white or brown. Shell thick, with 6-7 whorls, apex acute. Males smaller than females. Head projects, has conical tentacles with eyes at bases. Foot divided longitudinally so that as animal moves it swings alternately from side to side. Tongue 2 times length of animal. In shallow water or on rocks. Eats plant material. Eggs laid in masses on rocks and weeds. Eaten by man in Europe and in America. Also used as fish bait. Common in European waters. Introduced on our Atlantic Coast and now abundant from Labrador to Cape May, N. J.

77. Checkered Littorine. *Littorina scutulata*

Length to just over $\frac{1}{2}$ in. Greenish to brownish-gray marked with lighter white bands or spots. Inside of shell conspicuously purple at opening. Clings to rocks between tide marks. Kodiak Island, Alaska, to Turtle Bay in Lower California and Socorro Island.

Family Vermetidae

78. Worm Shell. *Vermicularia spirata*

Length to 10 in. Shell develops regular or irregular open spiral. Yellow, brown, or white, with thin membrane-like portion with which opening may be closed. Animal retreats deep into shell. Interior partitioned by cross walls. Foot not well developed. Head long, with 2 cone-like tentacles with eyes at bases and 2 other tentacles at sides of mouth. Essentially stationary. In crowded tangled masses in shallow water, in sponges, on coral, among weeds, or to depth of 1,000 ft. Vineyard Sound, Mass., to Texas and West Indies.

Family Cerithiidae

79. California Horn Shell. *Cerithidea californica*

Length to slightly over 1 in. Black outside, glossy within; 10 strongly ribbed whorls and relatively large circular aperture that is closed by thin brown operculum. In mud of tidal flats. Undisturbed by exposure to air. Bolinas Bay to San Diego, Calif.

Family Strombidae

Large, solid-shelled, conical-spired animals. Shells with expanded lips, deeply notched. Opening long, narrow, and may be closed by operculum. Eyes large, at ends of pair of long stalks.

80. Fighting Stromb, Conch. *Strombus pugilis alatus*

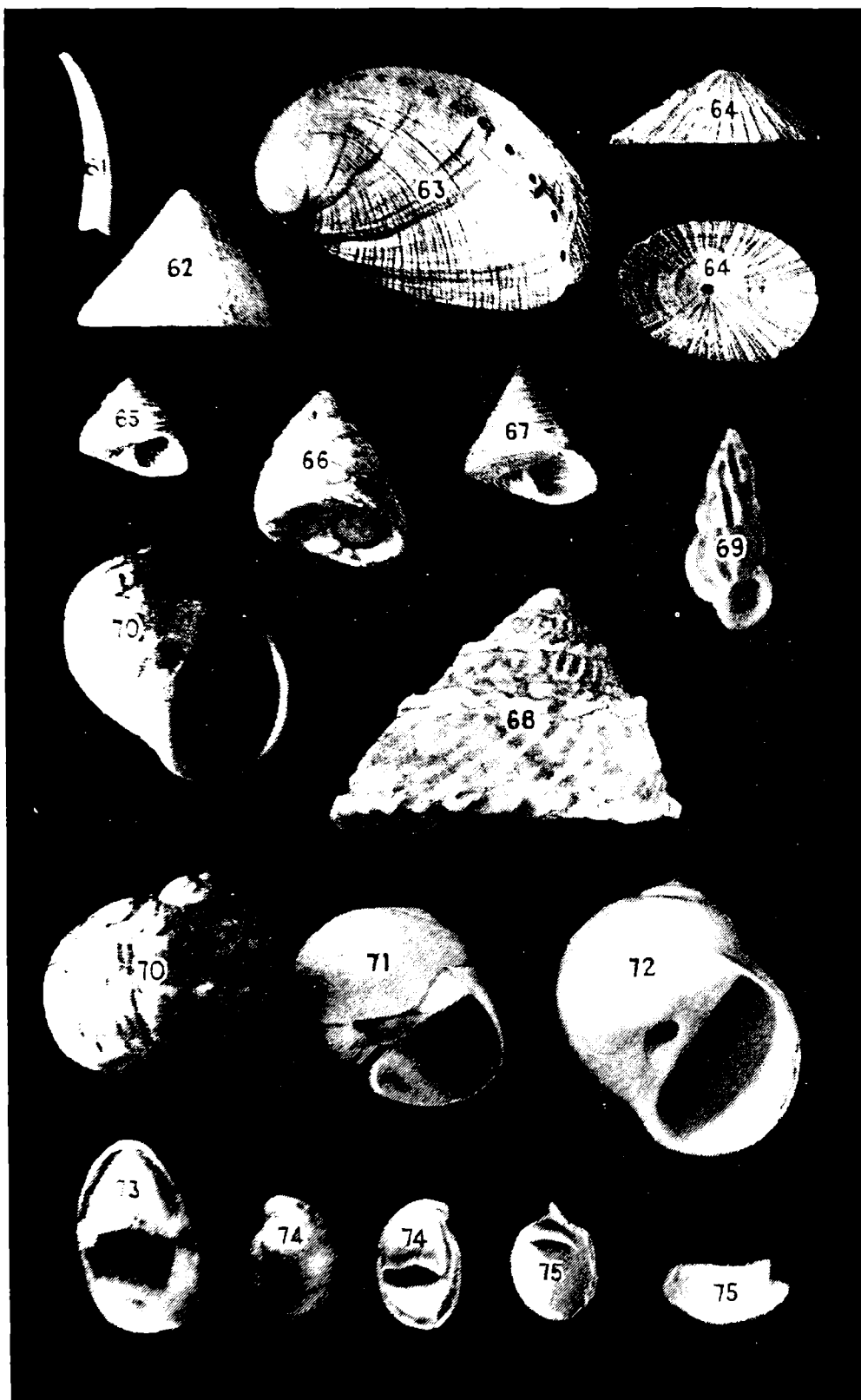
Shell to 4 in. long, orange to brown or purple, with thin skin that covers animal but wears off in age. Actively attacks animals by series of jumps from side to side. If upset, animal rights self by somersault motion. In shallow seas. North Carolina to Florida and west to Texas.

Family Tonnidae

Shells small-spired, with large openings in which animal is not protected by operculum, at least as adult.

81. Fig Shell, Paper Fig. *Ficus papyratia*

Shell brown with darker interior, to $3\frac{1}{2}$ in. long. Foot large. Siphon long and narrow. Cape Hatteras to Gulf of Mexico, along coast to Venezuela.



PHYLUM MOLLUSCA. CLASS GASTROPODA

Order Prosobranchiata Family Muricidae

Ancients extracted royal purple dye from members of this family that includes borers (*Eupleura*) and rock shells (*Murex*). Foot, long. Opening uniform in outline.

82. Festive Rock Shell. *Pterynotus festivus*

Length to over 3 in. Shell elaborately ornamented by coarse frills, ridges, and sculpturings. 3 growth ridges to a whorl. White, gray, or dingy, but when young sometimes brilliant scarlet. Clings to sunken weeds and trash. Best in warmer waters. Santa Barbara, Calif., to Cerros Island off Lower California.

83. Borer. *Eupleura caudata*

Length to 1½ in. Width ¾ times length. Shell brown, gray, white, or red-brown. 2 growth ridges to a whorl instead of 3 as in *Murex*. Foot yellow, remainder white. Lip, thick. About 7 angular whorls at maturity. Common at depths of 6–50 ft. Massachusetts to Florida.

84. Oyster Drill. *Urosalpinx cinerea*

Length rarely to 1 in. Growth ridges, 9 to a whorl. Yellow to gray but brown within. Foot small, with yellow border. Eyes small and black. Bores neat round holes through shells of oysters and other shellfish and sucks out soft parts. Eggs laid in parchment cases, each containing to a dozen eggs and attached in rows to rocks. Single female may lay 100 such cases in few weeks, usually placing them just below low-water mark. Probably oyster's worst enemy. Prince Edward Island to Florida. Also at San Francisco.

85. Leafy Hornmouth. *Purpura foliatus*

Length to over 3½ in. Breadth to over 2½ in. With 3 broad conspicuous wing-like, shingle-like structures and strong spiral ridges that spread in fan-like form. Dull white, but usually stained. Sitka, Alaska, to San Diego, Calif.

86. Sculptured Rock Shell. *Ocenebra interfossa*

Length to 1 in. Breadth to ½ in. Spindle-shaped with spirals marked by deep, well-defined grooves. Yellow, gray, brown, and dull outside but white inside. Appears coarse and rugged. Clings to rocks. Relatively common. Semidi Islands, Alaska, to Santo Tomas, Lower California.

Family Thaisidae

Short-spurred shells with no growth ridges. Many produce a crimson dye.

87. Little Rock Purple, Dog Winkle, Horse Winkle, Sting Winkle, Whelk. *Thais lapillus*

Length to 1¾ in. Reddish, yellow, white, or banded. Feeds on oysters, mussels, and other mollusks, whose shells it drills until its tongue can be thrust in to remove soft parts. Enemies include starfish, hermit crabs, fish. Eggs resemble pink rice on tiny stalks attached to rock surface, each group containing 29–40 young. One individual capable of producing more than 200 such groups. Eggs laid any time of year in capsules like slender eggs attached at one end and open at other. Injures valuable shellfish. On rocks, commonly in shallow water. Newfoundland to Connecticut and in northern Europe.

88. Wrinkled Thais, Purple Dog Winkle. *Thais lamellosa*

Length to 2 in. Exterior variable from smooth to wrinkled or frilled. Some are plain white, while others are conspicuously painted with rich brown bands. Usually conspicuously colored. From water line to depths of 150 ft. or more. Port Clarence, Bering Strait, to Japan Sea and east to Aleutian Islands, south to Santa Barbara, Calif. Also found in Pliocene and Pleistocene deposits of Oregon and California.

89. Unicorn Shell. *Acanthina spirata punctulata*

Length to about 1–1½ in. Mature spire has 4 whorls. Small opening bounded by series of tooth-like knobs. Appears like waterworn granite. Usually on rocks among seaweeds. Monterey, Calif., to San Tomas, Lower California, with relatives widening range considerably, particularly to south.

Family Nassariidae

Shells more or less egg-shaped, with lip-lining enamel spreading around opening; carnivorous.

90. Lash Nassa, Basket Shell. *Nassarius vibex*

Length ¼ in. Chestnut and white, in bands or washes that are brilliant in fresh shells. Shell with 6 whorls. Foot, forked behind. Vineyard Sound, Mass., to Gulf of Mexico.

91. Worn-out Basket Shell. *Nassarius obsoletus*

Length 1 in. or less. Width ½ length. Shell brown or muddy. Opening dark-brown with white bands. Body mottled gray. Animal commonly sand-covered. Eggs laid in spring on an empty shell; each sac spiny, transparent, stalked. Scavengers, or may bore shells of other shellfish, including own kind. Common where water is brackish at mouths of streams in shallow water. Probably commonest north Atlantic Coast shell. Gulf of St. Lawrence to Florida.

92. Tin-roof Dog Whelk. *Nassarius tegulus*

Length to ¾ in. With stout strong evenly tapering pointed spire and relatively small opening. Dark gray, with rather conspicuous bumps forming interrupted ridges from one end to other. Mud flats. San Francisco to San Ignacio Lagoon, Lower California.

93. Channeled Dog Whelk. *Nassarius fossatus*

Length to 1½ in. Diameter to ¾ in. In older animals, lip much thickened in outer areas. Pale ash-gray but with enamel showing at lip as bright orange. In mature shell, 7 whorls marked by conspicuously spiraling ridges crossed by more obscure coarse longitudinal ridges. Long breathing tube extends into clear water as animal feeds in deep mud. Vancouver Island, B. C., to San Ignacio, Lower California.

Family Columbidae

94. Frieze-covered Dove Shell, Eelgrass Shell

Mitrella carinata gausapata

Length to less than ½ in. About size of wheat grain, chestnut brown, polished, glistening and marked with spots, stripes, or dots. Spire conical. Lip thickened. At roots of eelgrass in enormous numbers. Forrester Island, Alaska, to Salina Cruz, Calif.

95. Columbian, Wrinkled Amphissa. *Amphissa columbiana*

Length to nearly 1 in. Light yellow-brown. Closely related to Joseph's-coat amphissa, which is about ½ in. long and variable in color. Found in mud where sea is about 100 ft. deep. Chiachi Islands, Alaska, to San Pedro, Calif.

Family Buccinidae

Shell with unusually large opening that ends in a wide notch or canal through which the siphon extends. Except in *Busycon*, shells lack color.

96. Waved Whelk. *Buccinum undatum*

Length to 6 in. Width ¾ length. Gray outside, yellow around opening, and usually white within. Several hundred eggs laid in half-pea-shaped sac; about 500 sacs fastened together in a mass. Newly hatched young feed on own kind, some 2 months being spent in egg sac, usually during winter months. Steals bait from fish hooks. Forms large part of diet of cod and other fish. Used as bait by fishermen. In Europe, fried and eaten in soups by man. Low-water mark to deep water. Labrador to New Jersey and in Europe.

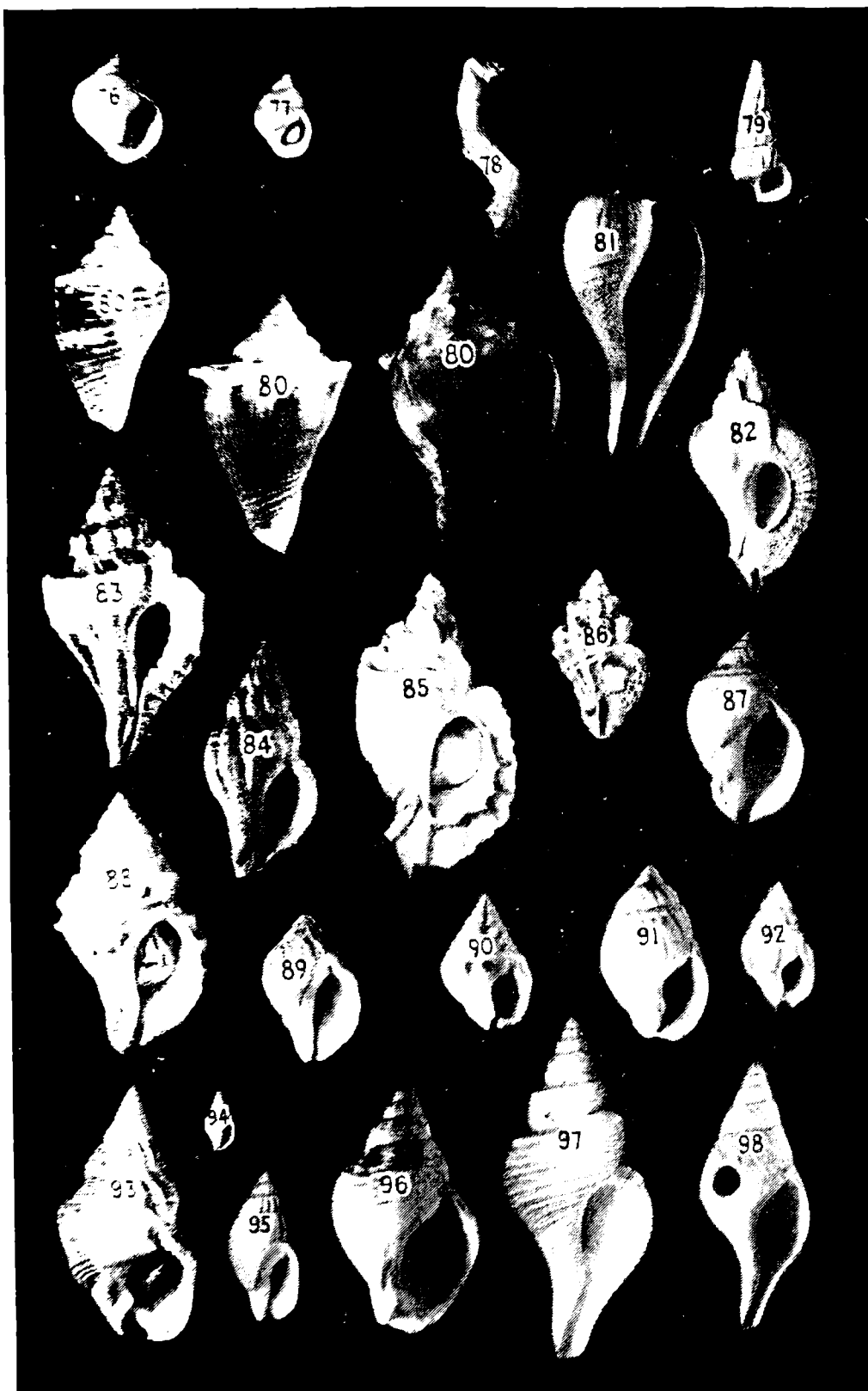
Family Neptuneidae

97. Tabled Whelk. *Neptunea tabulata*

Length to 5 in. Diameter to 2 in. Coarse beautiful yellowish-white with flat-topped whorls making a spiral table that gives common name. Outer lip thin and smooth. Inner lip hard and crusted. At depths of 150–1,200 ft. British Columbia to San Diego, Calif.

98. Short Distaff. *Colus simpsoni*

Length 3–6 in. Generally covered with velvet. In water 6–2,700 ft. deep, from Labrador to North Carolina, favoring deeper water in South.



PHYLUM MOLLUSCA. CLASS GASTROPODA

Order Prosobranchiata Family Neptunidae

99. Left-handed Whelk. *Busycon contrarium*

Length to 10 in. Fawn-colored with blue-brown stripes; when young, tan. Spiral turns to left. In India, such shells are sacred, so many are shipped from Florida to serve in ceremonies in Indian temples. Shell lining, shining brown. Animal, black. Eggs in cases, attached in row to long cord. Burrow in sand for food, which is largely other mollusks. Cape Hatteras to Cuba. Abundant on Florida west coast.

100. Channeled Whelk. *Busycon canaliculatum*

Length to 9 in. Brown, with numerous revolving lines. Channel follows joint of whorls. Egg sacs much as in knobbed whelk, but with narrow instead of double ridged edge. Indians made wampum of shells. Shells used as containers and as cutting tools. Shallow water. Cape Cod, Mass., to St. Augustine, Fla.

101. Knobbed Whelk. *Busycon carica*

Length to 11 in. Width about $\frac{1}{2}$ length. Usually smaller on Long Island. Gray to brown. Shell red within. Lip, thin. Knobs on outer whorl give shell its name. Food, soft parts of oysters and other shellfish procured by drilling small round beveled hole. Eggs laid during warmer months in disc-shaped sacs, with double ridge around edge, fastened on long spiral ribbon to a stone. Egg ribbons may be 1 yd. long. From ribbons emerge young whelks shaped like adults. Sandy beaches near oyster beds and elsewhere. Cape Cod, Mass., to Cape Canaveral, Fla.

102. Crown Melongena. *Melongena corona*

Length to 5 in. Shell pear-shaped, with curved flattened spines that give it a crown-like appearance. Spines arranged in 2-3 series. Surface polished. Preys on other mollusks, sticking long snout into soft parts and rasping muscle free. In shallow brackish water, usually under mud. Florida and West Indies.

Family Fascioliariidae

103. Giant Band Shell. *Fasciolaria papillosa*

Length to 2 ft. Shell solid, heavy, with 10 whorls. Strong ribs with less distinct ones between them. Reddish-brown epidermis over shell. Soft parts, conspicuously red. In shallow waters of tidal pools or open shores. North Carolina to Gulf of Mexico.

104. Tulip Band Shell. *Fasciolaria tulipa*

Length to 8 in. Shell somewhat tulip-shaped, with 9 well-rounded whorls, with sculptured region near line between whorls that is lacking in *F. distans*. Plain orange, dark mahogany, or other colors. Feeds on dead mollusks and crabs, as scavenger. North Carolina to Antilles.

105. Pale Tulip Shell. *Fasciolaria distans*

Length to $3\frac{1}{2}$ in. Shell gray, with shadowy white design or marked with 14 dark-brown bands. North Carolina to Mexico.

Family Cymatiidae

106. Oregon Triton. *Fusitriton oregonensis*

Length to about 4 in. Shell covered with shaggy brown hairy material in life. Inside of shell pure white. From line of floating ice in Bering Sea, near Pribilof Islands, to Sea of Okhotsk and Japan, and to San Nicholas Island and San Diego, Calif.

Family Cypraeidae

Cowry shells were important as media of exchange in primitive South Sea civilizations. Animals now sold to tourists or used as bait for octopuses that have food value. Ordinarily not easy to collect. Known to all South Sea travelers.

107. Chestnut Cowry. *Cypraea spadicea*

Length rarely to 2 in. Shell with brown center, with bluish lips beneath and about 20 whitish "teeth." Center of back lighter than adjacent area. Young with thin short-spined cones and large aperture. Rarely found. Monterey, Calif., to San Martin Island, Mex.

Family Triviidae

108. Solander's Trivia, Sea Button. *Trivia solandri*

Length to nearly 1 in. Shell black, with horizontal groove crossed by conspicuous ridges at right angles, the groove exposing white area that underlies colored surface. Dark chocolate brown to light pink variations found. Santa Barbara, Calif., to Panama.

Family Olividae

In *Olivia* there is no operculum protecting the opening. In *Olivella*, there is an operculum.

109. Lettered Olive Shell, Panama Shell. *Olivia sayana*

Length to $2\frac{1}{2}$ in. Shell usually with 2 bands of irregular markings and zigzag ornaments, tapering at both ends. Shell covered by animal in life, so that animal looks like piece of fat pork. Animals live in colonies, often buried in sand, and may inflict a dangerous bite. Few if any found alive in Florida.

110. Rice Shell, Purple Olive Shell. *Olivella biplicata*

Length to 1 in. Shell about size and shape of olive pit but smooth, polished, and beautifully marked. White to dark slate, usually with purple markings. Usually found just under surface of sand, with siphon extending to open water above. Vancouver Island, B. C., to Magdalena Bay, Lower California.

Family Terebridae

Shells are shaped like augers. Some species have poisonous glands.

111. Dislocated Terebra. *Terebra dislocata*

Length to $1\frac{1}{2}$ in. Animal has long proboscis with which it squeezes, suffocates, poisons, and sucks its victim to death. Movement normally sluggish. Egg cases on shells in May. Virginia to Texas.

Family Conidae

Name cone is almost adequate description. Shells heavy and china-like, with narrow opening. Some can remove inner whorls to increase available room. Some have poison glands and strike at their enemies or prey. Some have great value to collectors.

112. Florida Cone Shell. *Conus floridanus*

Length to 2 inches. Shell yellow-white blotched with brown, with indistinct white band at shoulder and at center. North Carolina to Florida.

Family Cancellariidae

113. Cross-barred or Nutmeg Shell. *Cancellaria reticulata*

Length to $2\frac{1}{2}$ in. White with brown bands. Surface finely ribbed and grooved. Slow and shy. Explores with fore part of foot and eats plants. Cape Hatteras to Guadalupe.

Order Opisthobranchiata

Family Bullariidae

114. Gould's Bubble Shell. *Bullaria gouldiana*

Length to 2 in. Shell thin, polished, mottled brown or white, slate or yellowish, of eggshell appearance and almost as delicate. Spire is pushed inward. In and on mud flats. Santa Barbara, Calif., to Mexico.

CLASS AMPHINEURA

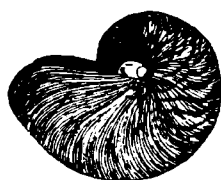
With plates resembling set of false teeth or section of tiled floor. Central plates described as "butterfly shells."

Family Mopaliidae

115. Mossy Chiton. *Mopalia muscosa*

Length to about 2 in., apparently composed of jointed sections bordered by moss-like hairs. Outside color commonly obscured by growths. Interior, bluish-green. Removed with difficulty from rock and may fall to pieces when dried. Ranges from Shumagin Islands, Alaska, to Rosario, Lower California.

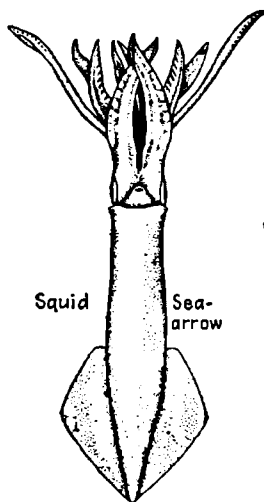




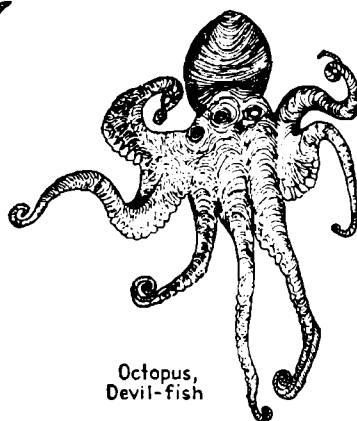
Nautilus



Squid



Sea-arrow



Octopus,
Devil-fish

PHYLUM MOLLUSCA. CLASS CEPHALOPODA

Cephalopods are marine, usually without an external shell, with a circle of long arms about the mouth, with from 8 to over 90 arms, and with head distinct from body.

Order Tetrabranchiata

Family Nautilidae

116. Nautilus *Nautilus pompilius*

Shell to 10 in. in diameter, coiled, with waving markings of alternating white and yellow-brown. Inside of shell pearly and divided toward center of coil by cross walls, cells left being filled with a gas. About 90 tentacles, in 4 groups of 12-13 about mouth, 2 groups of 17 larger tentacles, and 2 thicker ones.

Living species of *Nautilus*, 4; fossil species, over 300. Living forms dwell on sea bottom in Pacific and Indian Oceans, not floating on surface as sometimes suggested. Favors rather deep water but usually near shores. Group dates back to Cambrian, reached maximum development in Silurian and Devonian. This is not paper nautilus.

Oliver Wendell Holmes's description of chambered nautilus contains essence of animal's growth:

Year after year beheld the silent toil
That spread his lustrous coil;
Still, as the spiral grew,
He left the past year's dwelling for the new,
Stole with soft step its shining archway through,
Built up its idle door,
Stretched in his last-found home, and
knew the old no more.

Pursues and catches food in part because of semibuoyant shell. Tentacles lack suckers but hold prey firmly. Food is entirely animal matter caught by pursuit by squirting water through siphon. Eye, a deep pit with small opening which admits light to sensitive surface as in pinhole camera.

Shell used much in arts. Animal known to many schoolchildren through Holmes's poem. Paleontologists are interested in animal as a primitive form which has long persisted. Lacks ink sac common to squids and devilfish.

Order Dibranchiata

Family Loliginidae

117. Squid, Sea Arrow *Loligo pealei*

Length to 8 in. Width to 2 in. Body a flattened cylinder, pointed at fin end, with fin over $\frac{1}{2}$ length of trunk. Dark gray, with reddish spots. Tentacle-bearing arms partly retractile, with 4 rows of suckers. Arms, 10. Eye, with a cornea, conspicuous. Giant squids may be over 50 ft. long.

L. pealei very common in Atlantic Ocean from Maine to South Carolina. Related species, 31; 3 on our Atlantic and 2 on our Pacific Coast. Related cuttlefish is common in the Mediterranean. Giant squids, the largest mollusks, are sometimes found on Nantucket beaches.

Sexes separate. In some forms males introduce sperm capsules into female with a special arm and fertilization is internal. Eggs embedded in jelly and attached to objects on sea bottom. Young squid able to swim and capture food when it becomes free, after few weeks. Probably has reached $\frac{1}{2}$ in. when freed, 1 in. by 3 months, 2 in. by 5 months, and full grown in 12 months.

Swims by quick expelling of water or, if in danger, of ink, and by use of fins, with body being held horizontally. Common in schools; able to change color with remarkable speed. Sensitive to light. Food is held by tentacles and torn by sharp jaws.

Certain species are eaten by man. Squids form basic food of sperm whales and of many other marine animals. Harvested by tons as bait for codfish and other marine species and for use as fertilizer. Some are dried and shipped as food, 3 tons of wet squid producing 1 ton of dried, worth around \$10 a ton. Famed sea serpents are undoubtedly giant squids.

Family Octopodidae

118. Octopus, Devilfish *Octopus batrachi*

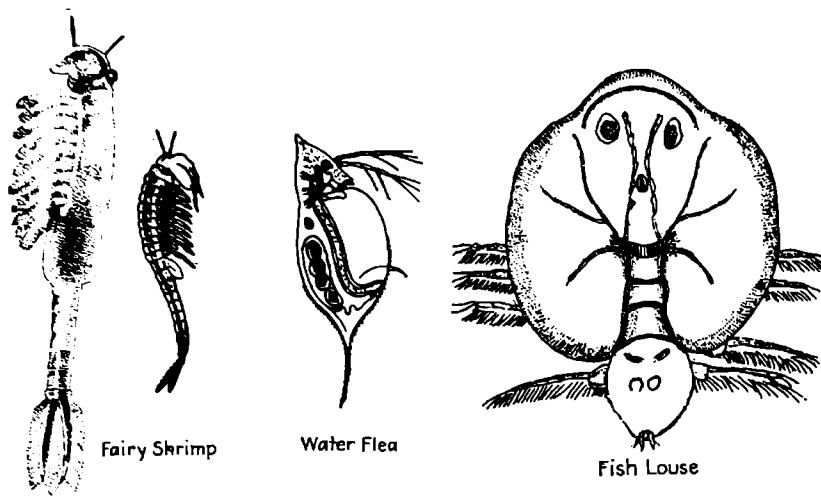
Body to 3 in. long and $1\frac{1}{2}$ in. wide, with 8 tentacle-bearing arms to 40 in. long, webbed $\frac{1}{3}$ their length. Bluish-white speckled with brown. West Coast species, *O. bimaculatus*, has a pair of large blue spots midway between eyes and third pair of arms from front.

Common in deep water of Atlantic north of Cape Cod and in Europe. On West Coast, *O. bimaculatus* is found from Lower California to Alaska. 4 Atlantic Coast species and 3 Pacific, with 50 in world. Paper nautilus is a close relative.

Sexes separate. Third arm on right in male modified for placing sperm capsule in mantle of female during mating. As in squids, eggs are attached to objects on sea bottom and hatch into well-developed young, which grow relatively rapidly where food is abundant.

Can walk forward on bottom or swim backward rapidly by ejecting water. Can change color to pink, brown, yellow, or black to match environment. Hides in crevices, coming out to capture prey with long arms. Prey drawn to mouth and paralyzed by poison of salivary glands. Food, mostly crabs, but it attacks man and is a ferocious fighter.

Eaten by men in many parts of world and greatly enjoyed by Orientals and Italians, who use arms in soups or preserved in oil. Considerable sport in capturing them by spearing with the help of flares.



Fairy Shrimp

Water Flea

Fish Louse

PHYLUM ARTHROPODA

These animals, including over 640,000 species, have segmented external skeletons that are shed during periods of growth, and segmented appendages. The 5 classes include the Crustacea (mostly aquatic); the Arachnoidea, including the spiders; the tropical and subtropical Onychophora; the Myriapoda; and the Insecta. Of every 6 known species of animals, 5 belong to this group.

CLASS CRUSTACEA

These gill breathers have 2 pairs of antennae. Commonly, the head and thorax sections are fused into a cephalothorax that in many cases is covered by a shell, the carapace. The 25,000 species are divided into 2 subclasses: the minute Entomostraca, which lack abdominal appendages, and the larger Malacostraca, which have them. There are 10,000 species in the subclass Entomostraca, divided into 4 orders, the Branchiopoda, the Copepoda, the Ostracoda, and the Cirripedia.

SUBCLASS ENTOMOSTRACA

Order Branchiopoda

The 800 branchiopods have flattened or leaf-like appendages to the thorax, with which they breathe and swim. There are 2 suborders, the Phyllopoda and the Cladocera.

Suborder Phyllopoda

Elongate, segmented bodies.

Family Chirocephalidae

Fairy Shrimp *Eubranchipus vernalis*

Length about 1 in. Semitransparent or pinkish-green. Male with larger claspers on head. Swims on back by waving appendages. Relatives include claw shrimps and tadpole shrimps.

After mating, spherical eggs are carried in sacs by female. Resting during summer is in egg stage. Young hatch the following fall into females which, after a number of stages, lay eggs. At approach of resting stage, males may develop; these mate with females and fertilize resting eggs. Males develop from unfertilized eggs. Winter eggs larger than summer eggs.

Common in fresh-water pools from fall to spring, with different species ranging over United States, southern Canada, and Mexico. Serve a slight function as food for larger animals, some of which are food for man.

Suborder Cladocera

Short, indistinctly segmented.

Family Daphniidae

Water Flea *Daphnia longispina*

Length about $\frac{1}{2}$ in., just visible as individuals to naked untrained eye. Body oval, with tail spine almost as long as body. Swimming antennae obvious. Head apparently bent forward under a helmet.

Sexes distinct. Females carry young in brood sacs. May go through winter as special eggs. A pool or aquarium with temperatures from 70-80°F. will reach a maximum population in about 21 days, so cultures are normally used and renewed each 3 weeks. Do not thrive in copper or zinc containers or where these metals form a part of the aquarium that has contact with the water.

Live year round in fresh water through America and Europe where dirty water and algal and bacterial food are present. Important as fish food, in studies of population cycles, in genetic studies, and as food for aquarium animals. One aquarium stocked with *Daphnia* will feed animals in many others.

Order Copepoda

Elongate and segmented, or modified as parasites. Thoracic appendages are cylindrical.

Suborder Arguloidea

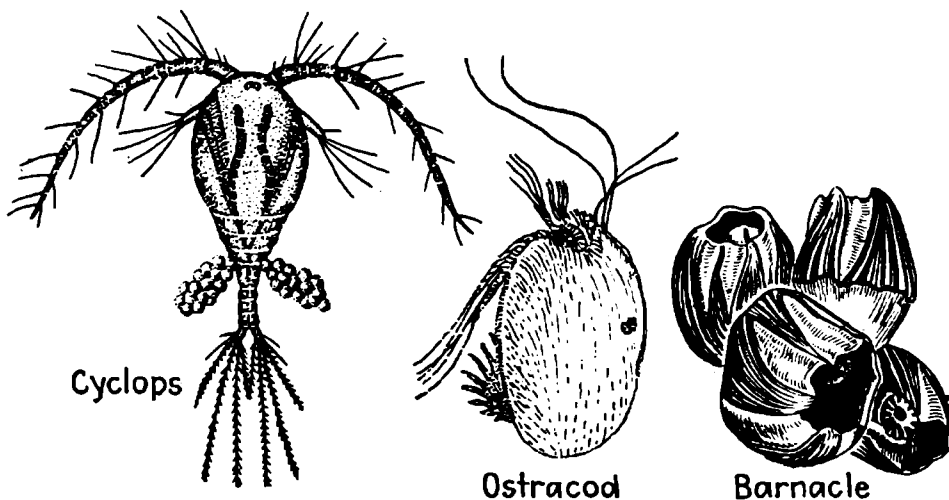
Family Arguloidae

Fish Lice *Argulus versicolor*

Body strongly depressed. A piercing organ in front of mouth. A pair of compound eyes, and a single eye on median line. Movable joint between fourth and fifth thoracic segments, but cephalothorax covered with a more or less round shell or carapace. Length $\frac{3}{8}$ in.

Copepods usually have first 4 pairs of legs suitable for swimming and the fifth, in male, suitable for grasping female. Egg sacs and genital openings are on sixth segment; 1-2 egg sacs. Eggs in this species not carried by female but fastened in rows to stones and other submerged objects.

This species is common on pike and pickerel in lakes of New England. Related species are found on other fish. Their presence on salmon may indicate that latter are fresh-run from the sea.



PHYLUM ARTHROPODA. CLASS CRUSTACEA. SUBCLASS ENTOMOSTRACA

Order Copepoda
Family Cyclopidae

Cyclops
Cyclops viridis

Body $\frac{1}{8}$ – $\frac{1}{4}$ in. long, but commonly not easily found in field. Usually greenish, and first noticed because of erratic motion caused by swimming strokes of antennae. First antenna 17-jointed and short; second, 4-segmented. First 4 pairs of legs 3-segmented; fifth pair 2-segmented. A single conspicuous red eye.

Commonest American species, widespread in ponds here and in Europe. Variable, the larger forms being the less common. Some relatives are found in the sea, sometimes in such great abundance that they color it red for miles around.

Female lays summer eggs which hatch quickly. Later, more hardy winter eggs are laid, and these see animals through severe conditions. Female carries as many as 200 eggs in her 2 conspicuous egg sacs suspended at middle of body. Young resemble adults in general form. Complete life cycle in 7 days.

Food microscopic plants and animals, captured in journeys through water. Sensitive to light, heat, and disturbance by jarring. Desirable in aquariums for keeping down protozoan population and keeping water clear, as well as serving as food for aquatic animals. More fertile with plant food than on a strict animal diet.

Important basic food for aquatic animals, including some whales. May be fed in aquariums with protozoa cultures made by steeping timothy hay in hot water for an hour, filtering liquor into open dishes, and inoculating with cultures made by keeping fresh horse manure in jars of tap water to which a little pond water has been added. A manure jar should be productive for 2 months.

Order Ostracoda
Family Cypridae

Ostracod
Cypria sp.

Like minute swimming clams, with swimming structures extending from one end between the "shells." 7 pairs of appendages. 2 pairs of antennae are used for swimming and for orientation. Length about $\frac{1}{8}$ – $\frac{1}{4}$ in.; shell about twice as long as wide. In some, shell is almost transparent, in others not.

Common at bottom of lakes, sluggish streams, and pools where there are dead plants and animals which have passed stages of active decay but where decay is continuing slowly. Some 2,000 species, living in salt or fresh water in America, Europe, and elsewhere in world. Most are marine.

Unisexual. Most lay eggs, which may be attached to refuse or carried within shell. In some genera, no males have been discovered, eggs developing without fertilization. Some have 2 shells when born; others do not. Young vary in degree of development at time of hatching.

Food largely microscopic animals, though some species live as parasites on larger animals like crayfish. Laboratory cultures may be maintained indefinitely if natural conditions can be approximated, but different species have specific requirements for light, temperature, food, and salinity. May be cultured from individuals or from egg masses found on stones.

Thin slices of potato or pieces of decayed lettuce in partly covered dishes of water provide reasonably good aquariums in which ostracods may be reared. They make excellent food for the earlier stages of fish, salamanders, and other aquatic animals, whose life histories should be known for wise conservation practices.

Order Cirripedia
Family Balanidae

Barnacle
Balanus tintinnabulum

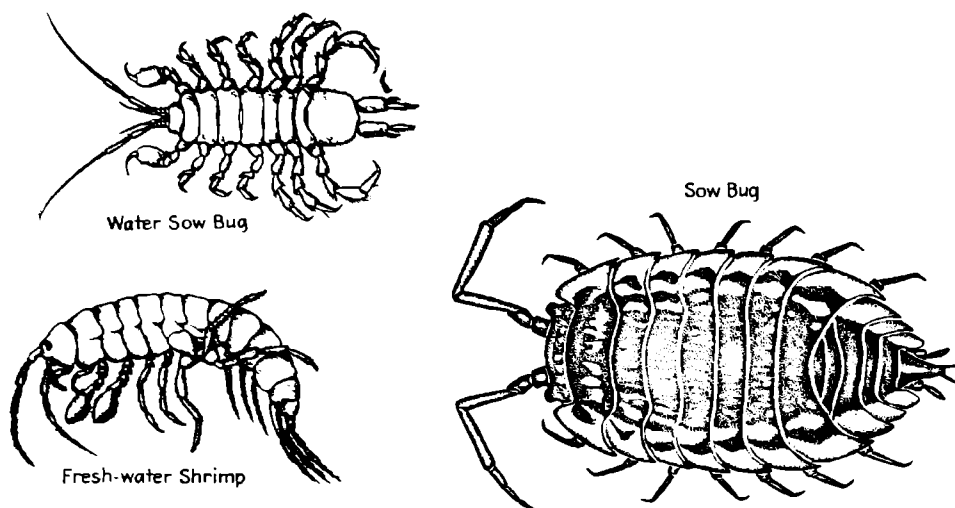
Rock barnacles are stalkless, with 6-plated shell joined by thinner shells to enclose soft body. Method of overlapping of plates is significant in classifying groups. In the goose barnacles the 3-pieced shell protecting feet and body is borne at end of a stalk from $\frac{1}{2}$ –12 in. long.

Ship barnacles are common on ships, piers, and logs, sometimes fouling them badly. Rock barnacles are common on rocks between high- and low-tide marks. Barnacles unfortunately are world-wide in distribution, except that they are not found in fresh water.

Sexes usually not distinct. Eggs carried outside fold of skin beneath shell. Young free-swimming "nauplius" stages swim near surface of sea; molt to 2-shelled "cypris" stage and swim about as butterflies fly; finally come to rest on support, where they remain for rest of lives and shed swimming legs.

Lies on its back inside shell, with legs extended from shell. Legs force stream of water, bearing food, to mouth. Legs move with clock-like regularity, giving a mass of barnacles a different appearance from a nonfeeding group. Highly sensitive to jar. In some species, males are small animals without mouths or intestines, living within female.

Some species have food value for man and for fish. Ship barnacles often cover bottoms of ships, retarding their speed though doing little actual damage to ship itself. Their removal causes much expense and delay.



PHYLUM ARTHROPODA. CLASS CRUSTACEA. SUBCLASS MALACOSTRACA

This subclass embraces over 15,000 species, including the shrimps, lobsters, and crabs. In most there are 7 segments in the abdomen, 8 in the thorax, and 5 in the head, the head being fused with some thoracic segments to form a somewhat shield-like carapace, though this is absent in some groups.

On this page are shown 3 of a tribe, the Peracarida, which embraces the carapaceless orders Amphipoda and Isopoda. The other orders are Mysidacea and Cumacea, which have a carapace. In the Amphipoda the body is laterally compressed; in the Isopoda it is flattened from top to bottom.

Order Amphipoda

Family Gammaridae

Fresh-water Shrimp

Gammarus fasciatus

Up to $\frac{3}{4}$ in. long, with high arched back, rather conspicuous antennae, and a brood patch carried beneath the larger female. In *Hyalella* first antennae are shorter than second; in *Gammarus* both are the same. Greenish-white to brown. Rather conspicuous eyespot.

One of commonest of smaller fresh-water shrimp-like crustaceans, ranging through America to Arctic Ocean, to Europe, and elsewhere. It thrives in aquatic vegetation, in swift or still water. Many species live in fresh or in salt water.

Mates April-November. Lays average of 22 eggs every 11 days, incubating them in brood sac about 11 days. Young are like adults except in size. Mature in 39 days, laying about 6 eggs first time. Adult may lay as many as 40. Mated pairs swim together for a long time, male smaller. Do not normally breed at temperatures below 64°F.

Swims backward, on back, by swimming legs. May eat own kind, or living or dead plants, or animals. Can see well and apparently has excellent sense of touch. Protected largely by fecundity, numbers, and hiding in sheltering food.

One of most valuable organisms for converting aquatic plants and small animals into suitable food for fish. Important food source in fish hatcheries and in nature. Serves as a scavenger. Too small to be directly significant as food for man.

Order Isopoda

Family Asellidae

Water Sow Bug

Asellus communis

Length to $\frac{3}{8}$ in.; breadth $\frac{1}{8}$ in. First pair of legs suitable for holding, others for walking; last 3 pairs longest. A single shield-like plate on abdomen. First pair of antennae short, second pair long. Sexes distinct.

Common among fresh-water vegetation and in oozes on bottom of pools and stagnant ponds. This species common through eastern United States, being there commonest aquatic isopod. Related species extend range through America and to other parts of world, there being 17 species in America.

Breeds during warmer months, mating and laying eggs every 5-6 weeks. Eggs carried by mother in a conspicuous whitish brood sac under front part of body. Young remain here about a month, until they reach stage where they can maintain independent existence.

Food dead or living plants or animals. In some cases mother may even eat her own young, or young eat brothers and sisters. Move by walking but may burrow in mud, leaving gill openings to rear protected by abdominal plate, thus preventing suffocation.

Serves role of scavenger, but may also serve as food for many common aquatic animals. Abundance in areas where decay is active indicates that it can live in water with relatively low oxygen content.

Family Oniscidae

Sow Bug

Oniscus asellus

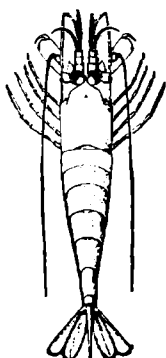
Length to $\frac{3}{8}$ in. Width $\frac{1}{8}$ in. Deep slate gray spotted with white, or light gray with white along edges of back. Related pill bugs, family Armadillidae, are able to coil themselves into compact spheres.

Common under stones and boards, close to soil or in rotting wood, under bark, and in similar places where there is some dampness, though this is not always obvious. Common in eastern and central states and in Europe, with related forms extending range widely over world.

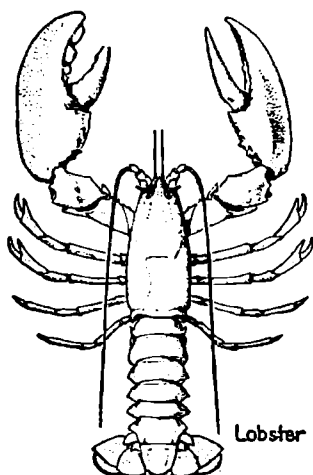
As in water sow bugs, eggs are carried by female in ventral brood sac formed by flat projections of thoracic legs. Young are like adults in general shape and appearance, there being no metamorphosis like that common in many other crustaceans.

Food organic matter, plant or animal, which abounds in places where they are found. They rarely live exposed to direct sunlight or great heat, even though humidity and food conditions might seem suitable for their needs otherwise.

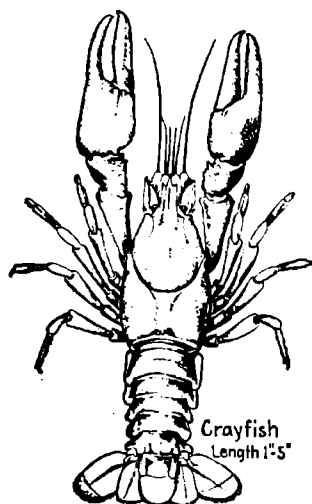
Serves essentially as scavenger and to some extent as food for enemies. Rarely develops abundance sufficient to be considered as pest but may eat young plants; controlled with Paris green bait.



Shrimp



Lobster



Crayfish
Length 1½-5"

PHYLUM ARTHROPODA. CLASS CRUSTACEA. SUBCLASS MALACOSTRACA
Order Decapoda (Over 8,000 living species)

Family Cragonidae

Shrimp

Crago septemspinosa

Length 2 in. Second pair of antenna long. Claws on second pair of legs like structures back of mouth, with pincers. In swimming, special abdominal appendages (pleopods) are used, this not being case in crabs and lobsters next discussed. In shrimps abdomen is well-developed and body more compressed than in crabs and lobsters.

Sand shrimps commonly found on and in sand at low-water mark and in shallow water on to depths of 300 ft. This species ranges from Labrador to South Carolina and in Europe and on Pacific Coast. Other species replace it on other shores, so that relatives are to be found on most seashores of the world.

After the mating, eggs are laid. Young stages in some species spent in egg. Some, from South, go through series of 4 larval stages, which are, in sequence, nauplius, protozoa, zoea, and mysis; in some species all 4 stages are passed within egg. Breathing by gills hidden in sides; swimming by flexing abdomen, which ends with tail fin and has swimmerets beneath, last help in carrying egg; walking by legs of middle of body.

Food captured by pincers, as in crabs and lobsters. May change color to match surroundings. Sensitive to light change. Hides when disturbed.

Industry important, particularly on Gulf Coast, Pacific Coast, and along Atlantic Coast of Southern states. Valuable bait and basic food for larger animals.

Family Homaridae

Lobster

Homarus americanus

Length to 2 ft. Weight to over 28 lb., average about 2 lb. Dark-green above, with darker spots, and yellowish beneath. First pair of claws large and used as pincers. First appendage of abdomen of male hooked, of female normal. 15-in. female may carry 100,000 $\frac{3}{8}$ -in. eggs under abdomen, 10-11 months. Young, transparent.

In shallow salt water in summer, in deeper water in winter. Very young swim at surface 6-8 weeks. Common along coast of Atlantic from Labrador to North Carolina. Individual may range 12 miles in 3 days. Dig holes into which they retreat backwards.

Mate in May. Eggs extruded in June, develop on female to second May. Young swim at surface 2 months. Average molts: first, aged 3 days; second, 6 days, $\frac{3}{8}$ in.; third, 11 days, $\frac{3}{4}$ in.; fourth, 26 days, $\frac{1}{2}$ in.; fifth, 41 days, $\frac{3}{8}$ in.; sixth, 46 days, $\frac{3}{8}$ in., goes to bottom; seventh, 56 days, $\frac{3}{4}$ in.; eighth, 70 days; ninth, 80 days, 1 in.; tenth, 90 days, $1\frac{1}{4}$ in.; twelfth, 175 days, $1\frac{1}{4}$ in.; fifteenth, 282 days; twenty-fifth, 5 years, $10\frac{1}{2}$ in., $1\frac{3}{4}$ lb. Mates. Frees first young at 6 years and every other year thereafter.

Sensitive to light, pressure, and chemical nature of water. Prefers water temperature about 55°F. Uses antennae as sense organs.

Probably our most valuable crustacean. In past, over 100 million captured a year, worth between 1 and 2 million dollars. Useful as scavengers and as food for valuable fish. Conservation demands that no animals be taken until they have freed the first generation of young or are over 12 in. long.

Family Astacidae

Crayfish

Cambarus bartoni

Length to 5 in. 2 large claws in front, 4 pairs of walking legs, long and short antennae, and jointed tails. Male with first appendage of abdomen hooked; female with this normal. Atlantic and Mississippi genus *Cambarus*, with 17 pairs of gills; Pacific slope genus *Astacus*, with 18 pairs. About 100 species in all, 70 of which are *Cambarus*.

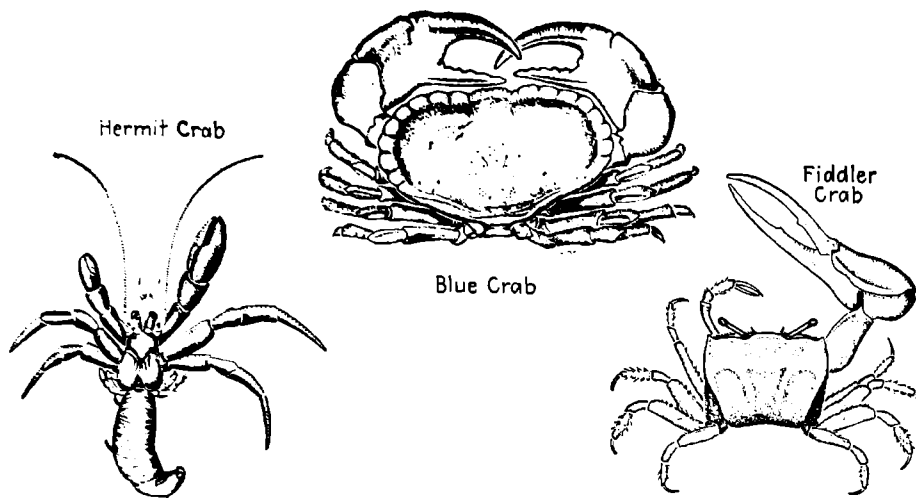
In fresh water, in streams or ponds, hiding under stones in small, excavated caverns, or among water plants. Some terrestrial, living in holes sometimes with turret entrances on "crawfish land" where water is near surface. Some species of *Astacus* found in Europe and Asia.

2 years from egg to egg. Mate March 6;* 200 or more spherical eggs laid March 24 and held under female's abdomen 2 months; eggs hatch, May 18; first larva, May 18-20; second May 20-26; third May 26-June 13, desert mother; fourth larva, June 13-30; fifth July 1-5; sixth $\frac{3}{8}$ in. long, July 6-17; by October, 2 in. long; by November, 2-3 in. long. Mates following spring and may lay eggs. May live 6-7 years. This species may mate and spawn through year; *C. diogenes* mates in fall, spawns in spring.

Food variety of plants and animals which may be caught and held with claws. Can regenerate lost limbs. Sheds outside skeleton as size increases. Then gets sand into pits on side of head which serve as balance organs.

Excellent scavengers. Superior food for many valuable fishes. May destroy fish eggs. Used as food in many large Eastern cities. Popular laboratory animal in biology and zoology classes where it is usually studied in its most uninteresting condition, dead and pickled. 333 tons harvested annually net \$34,000, with Wisconsin, Oregon, and Louisiana leading.

* Initial date selected at random.



PHYLUM ARTHROPODA. CLASS CRUSTACEA. SUBCLASS MALACOSTRACA

Order Decapoda

Family Paguridae

Hermit Crab
Pagurus sp.

Small crabs, usually about 1 in. long, found occupying spiral shells of other animals, with soft abdomen hidden in shell and claws protecting shell opening. Great variation in species and in kind of shell occupied. Abdominal appendages of female suitable for egg-carrying. Eyes on long stalks between antenna bases.

Some species found in shells on land, some even living in trees throughout their lives. Common species include *P. birsutiusculus*, Alaska to Lower California; *P. longicarpus*, Maine to South Carolina, in shallow water; *P. volutaris*, Maine to Florida, in deeper water. Over 100 species.

Coral-colored eggs, about size of mustard seeds, laid January-March. Early in year, zoea stage with short frontal spine appears as a free swimmer. Then comes glaucothoe (megalops) stage, in which animal is symmetrical and abdomen has 5 pairs of 2-branched appendages; this lasts 4-5 days. Then follows shell-occupying period. As crab grows larger, it seizes larger shells of dead mollusks or other hermit crabs and makes a rapid transfer.

Great fighters, readily attacking and killing own kind but retreating to protection of shell before more powerful enemies. Corals, sea anemones, and the like rest on shells. Walking is by second and third pairs of legs; fighting and food getting by first. Sensitive to light, touch, water pressure, position and other factors.

Serves as scavenger, as food for fishes, and as means of locomotion for organisms which live on the shell. One sea anemone consumes shell of host and lives directly on back of hermit crab, giving it protection.

Family Portunidae

Blue Crab
Callinectes sapidus

Width of shell $2\frac{1}{2}$ times length. Good-sized male, $2\frac{1}{2}$ by $6\frac{1}{2}$ in.; female smaller, with smaller claws. Apron under male, inverted T; of virgin female, equilateral triangle with concave sides; of fertile female, a plump triangle. Gray or blue-green. In family Cancridae, genus *Cancer* (illustrated), first antennae are folded longitudinally; in Portunidae, transversely or obliquely.

Blue crabs found in shallow salt or brackish water, chiefly on mud bottoms near river mouths where vegetation is abundant, from Cape Cod to east coast of South America, or sometimes in adjacent fresh water. Edible crab of California is *Cancer magister*, found along entire Pacific Coast.

Eggs light orange to brown, 1-5 million; in mass carried by female; hatch into free-swimming zoea, followed by quieter megalops, which develop into crab forms. Summer hatch transforms by winter. Molts weekly, later monthly, increasing each molt about $\frac{1}{2}$. Matures third summer. Adults do not molt. Males carry females before final molt. Females mate once. Males defend virgin females from rivals, may carry mates 2 days before mating and 2 days while mating. Females produce 2 lots of eggs each summer, the first several weeks after mating.

In summer, found close to shore; in winter, in deeper water. Larger males favor deeper waters. Soft-shelled, newly molted individuals hide. Build no permanent homes. Swimming movements so rapid animals appear like a flash. Run sideways. Sensitive to light, touch, chemical nature, and temperature. Food plant and animal matter, particularly decaying animal matter.

Valuable scavenger and important human food. Caught in nets or on lines baited with dead animal matter. Sold fresh, canned, or cooked. Provides some sport, and for many persons, a meager livelihood. Commercial value about $\frac{1}{2}$ million dollars a year.

Family Ocypodidae

Fiddler Crab
Uca sp.

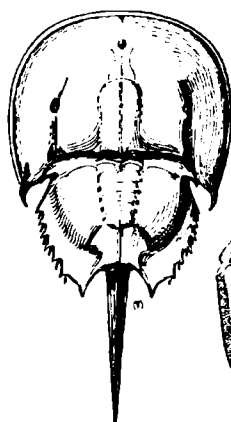
Shell width up to $1\frac{3}{8}$ in.; length to 1 in. Light brown to purple and dark brown. In male, one claw, usually right, is much larger than other; in female pincers are about equal in size. Eyestalks exceptionally long and slender. Among larger on Atlantic Coast is *U. minax*. Among smaller is *U. musica* (shell $\frac{1}{8}$ in. long), which makes a noise.

Found usually in droves at water's edge, or in burrows to 2 ft. deep or, as in *U. minax*, some distance from salt water and in fresh water. *U. pugnax* found from Cape Cod to Louisiana; *U. pugilator* from Cape Cod to Texas; *U. crenulata* (illustrated), in southern California; and *U. musica*, from Vancouver Island to Mexico.

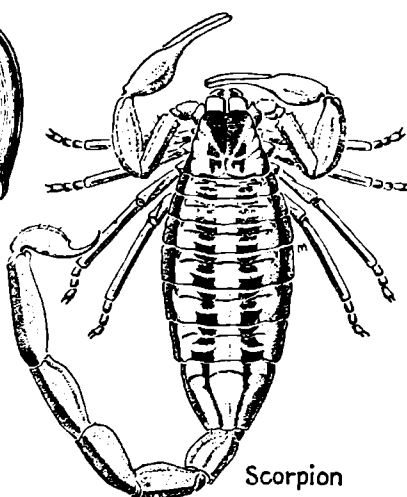
Male courts female with elaborate motion of huge claw, often leading her into tunnel. Eggs carried by female until young are able to shift for themselves, then freed gently into water, usually on an incoming tide. Free-swimming stages precede adult forms which are more sedentary; more or less similar to those of closely related crabs already described.

Food mostly small organic materials rolled into little pellets and often carried into burrow for use. Female uses both claws in food getting; male, the smaller claw only. Runs sideways, male usually holding large claw in threatening attitude. Obviously able to sense soil vibration well.

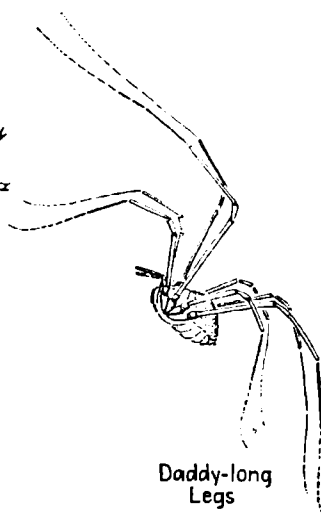
Of some value as food for such enemies as birds and fishes. Often trapped for use as fish bait. May burrow through dikes, causing damage by the resultant leaks. Essentially scavengers and always interesting to watch.



King Crab
Horse-shoe Crab



Scorpion



Daddy-long
Legs

PHYLUM ARTHROPODA. CLASS ARACHNOIDEA

Body of 2 divisions, the abdomen and cephalothorax: latter with 6 pairs of appendages but no antennae, former usually without appendages.

SUBCLASS MEROSTOMATA

The abdomen has gill-bearing appendages.

Order Xiphosura Family Limulidae

Horseshoe or King Crab *Limulus polyphemus*

Up to 20 in. long, with slender tail and broad flat forepart consisting of abdomen and still broader foresection. Relatively flat. Males much smaller than females. 2 large separated eyes and smaller pair close together. Back of abdomen flattened; bears along outer edges a row of movable spines.

In shallow sea water; along shore, in sand, at breeding time; below low-water mark, unless washed up by a storm. Atlantic Coast, from Maine to Mexico, with related species along eastern coast of Asia. 1 genus with 5 species. Midway between crabs and spiders, with some characters of each. Survivors of group of animals once abundant and widespread.

Mate in early summer, when large females come to shore bearing one or more slender males, each clinging to tail of animal ahead. Eggs laid in depression in sand prepared by female, fertilized by male, and left for waves to cover; hatch in midsummer. Young crabs, which may cover beach, finally make way to sea and disappear until well grown. Young lack spine-like tail. When molting, shell splits on front edge.

Walk with 4 pairs of front feet. Swim with hind feet. With help of shell, burrow in sand for small animals as food. Air breathers, even though they live in sea. Protected by shell and hiding ability. Not aggressive. Feed mostly at night.

Commonly fed to hogs and chickens or used as fertilizer. Some people consider them good food, but generally they are of little economic importance, in spite of their generous size.

SUBCLASS ARACHNIDA

The abdomen in this subclass lacks appendages. Some 36,000 described species in 11 orders; those on this page with segmented abdomen.

Order Scorpionida Family Centruroides

Scorpion *Centruroides* sp.

Members of this order usually have a long segmented "postabdomen." In this family, there is usually a spine under stinger at end of postabdomen. Length of species shown about 3 in. Pair of claws in front helps hold food. Flexible tail brings stinger into play when needed. Some species reddish, some yellow, some green.

About 300 species, 25 of which are found in United States, from North Dakota west and southeast. Common in drier areas. Not common northeast of line from North Dakota to Carolinas, but increasingly common southwest of that line. Found in open, in wooded areas, in buildings, and in a great variety of places. Some tropical species to 10 in. long.

Male courts female, mates with her, is commonly eaten by her after mating is over if not before. No eggs laid; incubated in enlarged female. Young up to 60, may live for week or more clinging to back of mother before leaving to maintain independent existence. 2 adults rarely together unless mating or one is eating other.

Sting of no United States scorpion known to be fatal to a healthy adult human being, though it may in some cases cause vomiting, convulsions, and death to children. Tropical species much more dangerous. Not affected by own poison so cannot commit suicide. Active, mostly at night, seeking shelter in shoes, clothing, or cervics at dawn.

Dangerous to man but more dangerous to insects. Their prey is primarily insects and spiders, which they hold, then paralyze, then eat. In scorpion country clothing should be shaken before it is put on.

Order Phalangida Family Phalangidae

Daddy Longlegs, Harvestman *Liobunum vittatum*

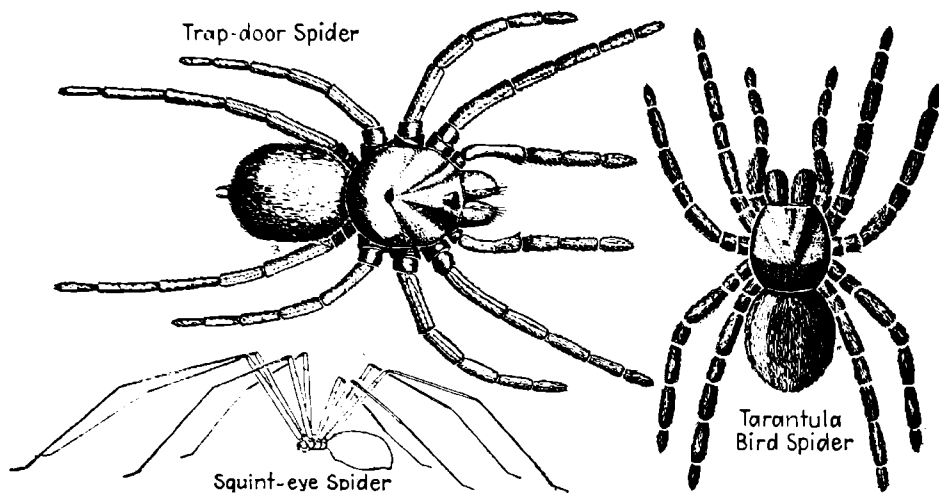
Spider-like, with body $\frac{1}{2}$ in. long, and 8 legs varying in length from 1-2 in.; second pair longest. Body brown, legs black. Male smaller bodied and more brilliantly colored than female. Abdomen segmented (unlike spiders), and with effective stink glands.

In fields and meadows, or sometimes crowded in considerable numbers in holes in logs or in brush piles, but usually close to ground and most commonly more or less solitary. About 60 American species, comprising 2 families and 15 genera.

Eggs laid in fall through a long ovipositor which is thrust underground or into debris; hatch in spring. Young white, with black eyes at first, but otherwise much like adults, whose color they soon develop. By fall young have matured, then they mate, lay eggs, and most individuals die, wintering being in egg stage.

Food small insects and other animals, or decaying or dead matter. More or less nocturnal, though may be active on bright sunny days. Build no web or nest. Move relatively slowly, getting some protection from noxious odor. May shed legs and effect escape, though this may provide poor protection against persistent enemy.

Interesting to children who have been told that they will point in direction cows are to be found. Since they point in all directions, this is a reasonably safe but useless generalization. General role probably that of scavenger. Of little economic importance.



PHYLUM ARTHROPODA. CLASS ARACHNOIDEA
Order Araneae. SPIDERS

Unsegmented abdomen distinct from cephalothorax.

Family Ctenizidae

Trap-door Spider
Cteniz californica

Large. Body of adult female $1\frac{1}{4}$ in. long. Legs long and stout. Color of whole spider rich dark chocolate brown, with legs slightly darker. Third claw well developed with rake for hole digging; this absent in web-building tarantulas.

Half-dozen American genera of trap-door spiders, some with several species, closely related to tarantulas. Fairly common throughout southern and western United States, but more common farther south. Lives almost wholly on or under ground, in burrows which may be 6 in. or more deep.

Life history habits in general similar to those outlined for tarantulas. Young remain in nest burrow with mother for about 8 months, leaving home burrow after winter rains cease and establishing own burrows. New layer of web added to door each year. May live over 7 years.

Food largely insects and other small invertebrate animals which can be captured with quick forays from nest. Life of trap-door spider is dominated by fear, particularly of parasitic wasp enemies, of which there are many. Highly sensitive to jar and to light. Can hold cover of nest shut from beneath.

Useful as destroyer of insects and similar animals captured at burrow entrance while door is held open by abdomen. Some tunnels have 2 doors; some branched, all lined with waterproof silk; some camouflaged at entrance. Excellent terrarium and garden pets; harmless.

Family Pholcidae

Squint-eye Spider, Pholcus
Pholcus phalangioides

Body about $\frac{1}{4}$ in. long; longest legs just over 2 in. long. Body conspicuously long and slender for a spider, pale brown in color. Might easily be confused with daddy longlegs but for presence on web and general body characters which make it a true spider.

Closely related to house spider, though not in same family. American species of genus 2; related American genera 6. Common in cellars, under porches, in houses, both in Europe and in America. Closely related species limited, for most part, to Florida region. Favors dark warm places.

Eggs laid in inconspicuous egg sac that female carries about with her, rather than leaving it hanging in web as does house spider. Egg sac thin, seen only when looked for carefully. Young develop in eggsac and, when released, live for awhile on mother's web.

Builds a large irregular web which is loose and open. Spider hangs head down on web, except when alarmed. When prey enters web, spider jumps around on web, shaking it violently and entangling victim, which is then killed. Food almost exclusively small insects caught on web.

Useful as destroyer of insects and interesting because of its behavior on loosely hung web. Of course it clutters up neglected places with its webs, but this does no great harm, and insects captured cannot do harm they might do otherwise. Lives comfortably in dark box if fed.

Family Theraphosidae

Tarantula, Bird Spider
Eurypelma californicum

Largest of American spiders, some species measuring 2 in. in length of body alone, with legs correspondingly large. Body and legs conspicuously velvety. Legs stout but able to carry spider rapidly. One South American tarantula has legs that spread over 7 in.; another has body $3\frac{1}{2}$ in. long.

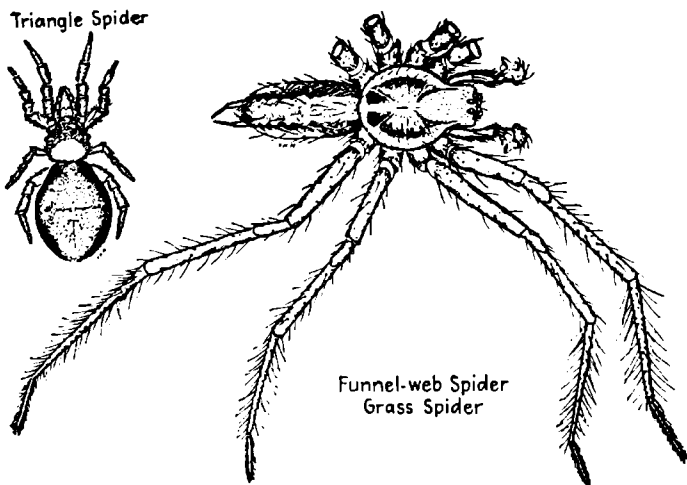
Closely related to trap-door spiders; about 40 species in family but does not belong to same family as Italian spiders whose behavior gave name tarantella to a dance. Lives on or near ground, hiding in holes under stones and in logs and debris. Common in southwestern United States.

Mates in fall. Following summer female puts 300-600 eggs in thick-walled cocoon, which she protects. Young grow slowly first half year, rapidly next 4-5 years, molting about twice a year, living as long as 16 years. Only 2-3 may mature out of an initial 5,000 young.

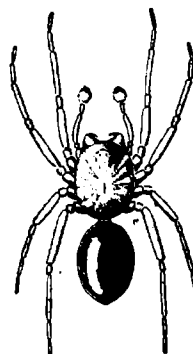
Not poisonous in spite of contrary convictions. Bites painful but not serious because jaws are suitable for crushing its food of insects. Some species can kill birds. When annoyed, assumes defense attitude. Can hear camera click. Bites only when forced to do so. Largely nocturnal. Common prey of wasp called tarantula hawk.

Valuable as insect destroyer, of no serious injury to man's interests, so really worthy of protection. Relies on sense of touch. Probably cannot see difference between light and darkness but seems to be "charmed" by bright light at night. Makes excellent terrarium pet and thrives if given reasonable care.

Triangle Spider

Funnel-web Spider
Grass Spider

Balloon Spider



PHYLUM ARTHROPODA. CLASS ARACHNOIDEA

Order Araneae. SPIDERS

Family Uloboridae

Triangle Spider

Hypiotus cavatus

Male $\frac{1}{2}$ in. long. Female $\frac{1}{8}$ in. long. Generally inconspicuous. Back of female with 4 hair-bearing humps, which in male are less conspicuous. At rest, closely resembles tree bud, for which it is commonly mistaken until it moves on being disturbed.

One species is best known in United States, but there undoubtedly are others as yet undiscovered; possibly present on West Coast in closely related form. Found on dead twigs, commonly in gorges and similar places where air may be relatively quiet. Usually on a twig next web.

Egg sacs not easily noticed as they are placed on twig and resemble bark or silk. They are oval and flat and have an outer covering over $\frac{1}{4}$ in. sac. Covering is gray like bark, or dirty white due to fact that portions are made of black silk mixed with white. Young hatch in brood sac.

Makes triangular web of 4 threads with cross threads, one corner terminating in single long thread. Spider takes up slack on this long thread, and when prey enters web, releases it to snap web and tangle prey in meshes. Rests feet uppermost beneath this trip cord, slack lying loosely between front and hind feet.

May be kept in a small bottle, where it will build its web, lay its eggs and, if food is available, live with reasonable comfort. Too small for general appreciation. Included here because of unique method of capturing prey and because of remarkable resemblance to its immediate environment. Protective coloration almost perfect.

Family Agelenidae

Funnel-web or Grass Spider

Agelena naevia

Medium-sized, varying in size and color but with 2 longitudinal black lines bordering gray lines on the back. Male $\frac{1}{2}$ in. or less long. Female up to $\frac{3}{4}$ in. long. Legs do not vary greatly in length. Median gray band down back serves as quick rough identification character.

4 species of genus found in United States; genus also represented elsewhere in world. Commonly found on or near their webs in grass, on lawns, in meadows, most conspicuous when webs are covered with dust or dew. Probably one of most universally common spiders.

Live only 1 year, winter being spent in egg stage. Adults die soon after eggs are laid. Eggs in irregularly shaped flat sacs, under rubbish and usually protected by female until her death. Male wanders in late summer, visiting webs of females, seeking mating, but may be eaten for his trouble.

May stay on one web all summer if undisturbed, web being enlarged with season. Trip thread common between supports above web. Spider runs on top of web (unlike most spiders), and hides in funnel which has a rear escape from which prey may be pounced upon. Webs of young seen by May.

Useful as a destroyer of insects that may be injurious to crops. Most excellent subject for study in fall biology because of abundance, food-getting habits, physics of nest, sensitivity, locomotion, and protection. May be attacked by parasitic wasps. Webs used by some birds in nest making.

Family Micryphantidae

Balloon Spider

Erigone autumnalis

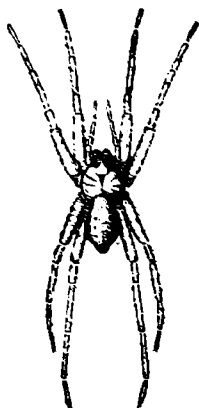
Body about $\frac{1}{20}$ in. long, easily recognized by generally light color and bright yellow head. Male has claspers used in holding female in mating. Related species are mostly larger and darker in color. Legs moderately long. Movement relatively slow. Does not frighten easily.

About 95 species of family and 30 of genus. 4 American genera. Found for most part on ground, in grass, among leaves, moss, and other small plants where they spin their small webs during summer months. In fall found high on some post or exposed plant.

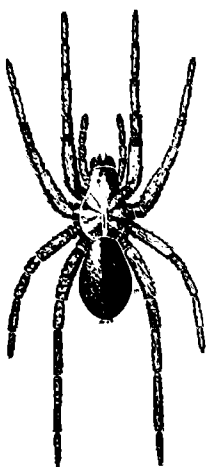
Little known of life history. One member of family builds dome web about 3 in. across; others build small webs like plain sheets. Some favor houses; others, fields; and others, woodlands; but all are most commonly inconspicuous; webs usually noticed only when dew-covered.

About time first frosts appear, great numbers of erigonids climb to elevations and spin long streamers of web when air is rising, which serve as balloons to journey great distances. Sometimes streamers cover a field, causing "gossamer," "flying summer," or "old-woman's summer" effects.

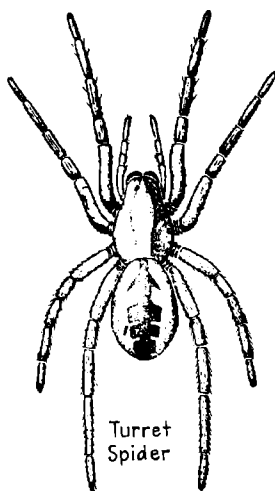
So conspicuous are gossamer threads when covered with dew or frost that everyone has noticed them in season. These little spiders probably do some good in controlling small insects that might be enemies of useful plants.



Water Spider



Wolf Spider



Turret Spider

PHYLUM ARTHROPODA. CLASS ARACHNOIDEA

Order Araneae. SPIDERS

Family Pisauridae

Water or Nursery Spider

Dolomedes urinator

Large, long-legged, the sexes differing so greatly that they have been described as separate species. Male with conspicuous yellow band around fore part of body. Female with large abdomen bearing median yellow band, with 3-6 pairs of small yellow or white spots. Relatively active, with remarkable locomotor abilities.

One of a rather large family of nursery-web spiders. By some, grouped with wolf spiders, the Lycosidae, but in *Dolomedes*, upper row of eyes is less curved and smaller. *Dolomedes* commonly found on, under, or near water, and because of skill in diving is sometimes called diving dolomedes.

Eggs laid in egg sac almost equal in size to that of abdomen of female; may number to 300. Young freed by mother when sac becomes mottled; may be guarded in web nursery, or in web under stones. Young feed on each other at first; not fed by mother. Web made just as young are freed from sac.

Feed on water insects and other small animals caught largely by pursuit. Normally wary; hide skillfully under water or vegetation. Webs built apparently only for protection of young. A $\frac{3}{4}$ in. spider has been known to capture and drag from water a fish $3\frac{1}{2}$ in. long weighing 4 times as much as spider.

Probably serves some role in maintaining balance among small animals of waterways. Most interesting because of ability to swim under water, to build and use rafts from which to dash after prey, and because of webs which so obviously serve as a nursery. Harmless and should be studied more.

Wolf Spider

Lycosa bellua

Medium-sized. Male about $\frac{1}{2}$ in. long. Female $\frac{3}{4}$ in. long. Color gray, yellow, grayish-brown, or brown, with a narrow yellow middle stripe down the back. Legs shorter and stouter than those of water spider *Dolomedes*, although some species of *Lycosa* have relatively slender legs.

In same general group with water spiders and turret spiders, a group including a majority of larger spiders which run on ground without making nets. Commonly found on or under stones or in holes underground; when pursued, runs rapidly, even going onto or under water to escape many enemies.

Eggs laid in spherical sacs, each consisting of 2 pieces. Sacs carried by female near rear of body. Female frees young from sac and they may crawl over her body, taking a ride with her wherever she goes. Young soon leave parent and shift for themselves. Female builds a silk-lined nest for shelter in early summer.

Food small animals, mostly insects caught by pursuit. May be active during day but most active at night when its food is more active and its enemies, such as many wasps, are less active. Fight between wolf spider and wasp, which uses spider as food supply for its young, is well worth watching.

Probably of considerable importance in controlling insect enemies of plants of fields and gardens. Difficult to conceive as harmful to man's interests. Makes excellent and interesting terrarium pet for home, camp, or school and should be better known.

Turret Spider

Geolycosa arenicola

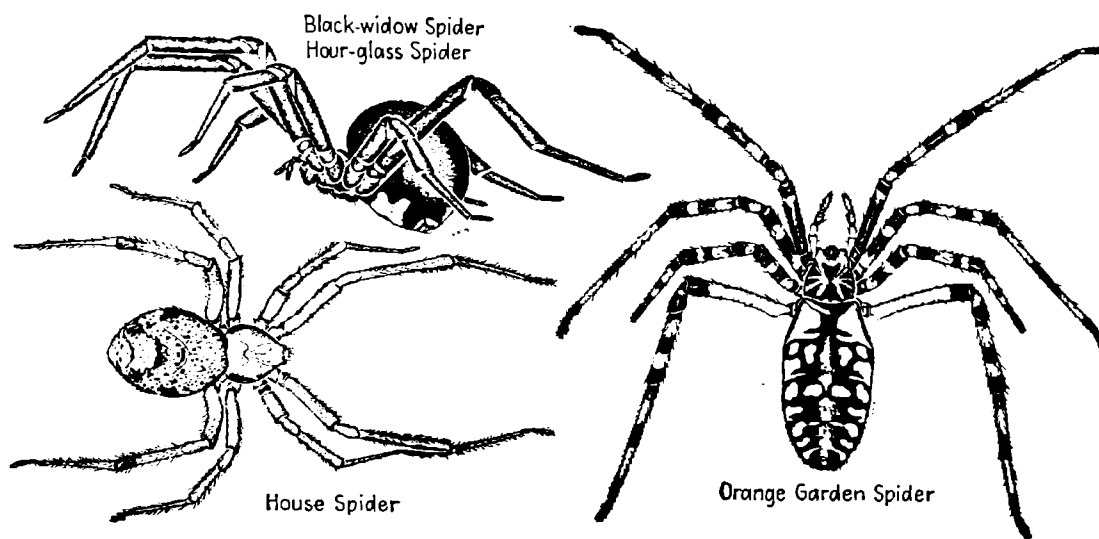
About $\frac{1}{8}$ in. long, with stout body and strong legs. Male more slender than female. Reddish-brown obscured by gray hairs, with broad light band down back which becomes narrower toward abdomen. Body hung low; female's abdomen conspicuously larger than that of male.

In same general group with wolf spider, which it resembles slightly. Roughly 114 species in America in family Lycosidae, all of which live on or near ground. This species digs burrows underground, entrance being marked by little turrets of sand.

In late May, male courts female; usually eaten by her after mating. In June, female retires to burrow, closes it, spins and protects cherry-pit-sized cocoon containing eggs. Young emerge from cocoon in July, live on mother's back, molt twice by August, leave to dig own burrow. Mature in size by third fall. Sexually mature the next spring.

Preys on small animals caught by pursuit. First year, burrows few inches deep; second year, 10 in. or more; mature spider burrows to 18 in., often ending in enlarged cell in which winter is spent. Entrance turret may be reinforced with plant material. May go months without food without ill effects.

Useful enemy of insects that may injure plants. Worth studying because of great sensitivity to jar, light, odor, sound, and moisture. Can be frightened by footsteps 12 ft. from burrow entrance. Will come to entrance if beam of light is centered on it. Rushes to entrance of burrow at slightest disturbance.



PHYLUM ARTHROPODA. CLASS ARACHNOIDEA

Order Araneae. SPIDERS

Family Theridiidae

Black Widow Spider

Latrodectus mactans

Black, with hourglass-shaped red spot beneath abdomen, latter large and almost spherical. Body of female $\frac{1}{2}$ in. long, over twice size of male which is less than $\frac{1}{4}$ in. long. Legs slender, front and hind pairs longer and more slender than middle pair.

From New Hampshire to Patagonia and west to Pacific Coast but more common in southern and western United States. Favors damp dark areas such as are found in cellars, under boards, in stone walls, and frequently in outhouses. Closely related to harmless house spider.

In June or July female makes 3-4 $\frac{1}{4}$ -in. cocoons, each of which may contain about 300 eggs. Young hatch, feed on each other. In few weeks survivors emerge from cocoons and begin eating spiders, insects, and other small animals. May mature and breed by fall, and females may live through winter.

Not ferocious, normally must be forced to bite. Bite causes serious discomfort. While death has been reported in 10% of those bitten, no record of death occurring to a healthy adult human. Pain in general not accompanied by great local swelling; slight temperature lasts 3 days.

Entitled to worst reputation enjoyed by any spider. If bitten, use ligature, cut wound, apply weak ammonia and carbonate of potash. Since bite tends to paralyze bowels, cathartics should be used also. Name black widow probably resulted from habit of female eating male, but this is common in other spiders as well.

House Spider

Theridion tepidarium

Female with body $\frac{1}{4}$ in. long. Male with more slender $\frac{1}{8}$ in. body. Legs nearly 3 times length of body. Exceedingly variable but possessing several dark chevrons above end of abdomen and on underside. General appearance dirty and dusty.

Over 300 species of genus have been described, about 40 of which are found in North America. *T. tepidarium* is most common species. Commonly found in and about houses, particularly in dark unused places such as under porches, in attics, and like.

Males court female, but may be eaten if unwelcome or after mating. Eggs 50-200, laid in spheres hung in webs 6-8 weeks after mating, hatch in 1 week. In next 8 weeks young pass through 5 molts; leave cocoon in second stage, web of parent in third. 9 cocoons may be made in one season.

One mating fertilizes eggs of many cocoons. At first young feed on each other, then on scraps in mother's web. Finally leave to make own webs. Webs irregular; adults may or may not have place in which to hide and await prey. Fourth pair of legs has comb of fine teeth which help fling silk on prey.

Ability to adapt itself to varied climates has made species almost world-wide. Useful as destroyer of house insects such as flies, moths, and mosquitoes. Webs collect dust. Should be studied living in every biology class in preference to too much book reading.

Family Argiopidae

Orange Garden Spider

Argiope aurantica

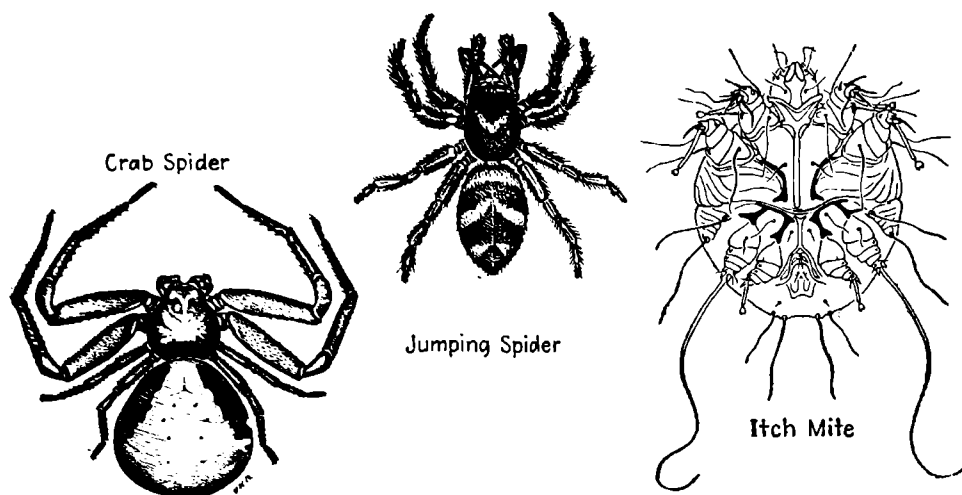
Large, black and yellow. Male about $\frac{1}{4}$ in. long. Female about 1 in. long, with front legs as long as body. Colored conspicuously, with rear of body black, and with bright orange or yellow spots that form a band along sides.

Rather closely related to silk spiders, from whose silk cloth has been made. Appears frequently in literature as *Miranda*. About 120 American species. Favors marshes, gardens, or tall plants protected from wind. Webs sometimes found on shrubs.

Male and female build similar nests. Male visits female's nest in fall; after mating, female lays eggs in paper cocoon size of hickory nut, which is firmly fastened to vegetation. Eggs hatch in midwinter but young remain in cocoon until May. Mature by midsummer, disappear by October.

Remarkable web, sometimes 10 ft. across, with ladder-like structure near center and shelter web where adult hides. May add secondary web near center. Can kill large grasshoppers; that land in web, by enmeshing in silk and then biting. If frightened, drops to ground and hides in vegetation. Web remarkably strong.

Probably useful as insect destroyer. Physics of web worth studying. New web usually made each night. Not all portions of web are sticky, as may be discovered easily. Spider is commonly parasitized by ichneumon flies, which may themselves be parasitized.



PHYLUM ARTHROPODA. CLASS ARACHNOIDEA

Order Araneae. SPIDERS

Order Acarina. MITES

Family Thomisidae

Crab Spider *Misumena vatia*

Medium-sized, with front legs spreading 3 times body length. Male $\frac{1}{8}$ – $\frac{3}{8}$ in. long. Female $\frac{1}{3}$ – $\frac{1}{2}$ in. long. Color yellow or white, depending upon flower upon which it lives; usually with pink or red markings. Male usually darker, particularly on sides.

A dozen species, distributed through United States, a number from Far West. Commonly found on flowers or resting in throat of some bell-shaped flower. In spring seems to favor white flowers; in fall, yellow; may change from white to yellow in 10–11 days. Not common in winter.

Eggs placed by female in flattened silken sac which is composed of 2 equal parts. Female protects sac and young, sac usually fastened to some leaf or other plant part and hidden on some incurled surface. Young feed on each other until they leave sac to shift for selves.

Makes no web but lies in wait, usually in throat of flower, to capture insect visitor, then hangs on with hind legs while forelegs are used in capturing prey, even though this means a struggle when prey is larger than spider itself. Most active in warm sunny seasons.

Possibly useful as insect destroyer but always interesting as garden or terrarium pet. May wander from flower to flower, but if hiding places are limited, may usually be found easily. If disturbed may stay for days in a single flower.

Family Attidae

Jumping Spider *Salticus scenicus*

Relatively small. Female slightly larger than male, reaching length of $\frac{1}{4}$ in. Male conspicuous even to naked eye, because of larger mandibles or jaws which hold female in mating. Gray, mottled, hairy, with numerous white bands and spots. General appearance flat or low. Front eyes touch each other.

Only common species in United States, but widely distributed even into Europe. 3 other species not so common. Found on walls of rooms, on window casings, on fences, barns, wooden houses, commonly where it is sunny or where wood has been weathered. Not offensive in spite of its abundance.

Male courts female by dancing before her, spreading his legs out at sides and up over his back and head. Eggs laid early in season in cocoons, often several in single nest; hatch early. Young guarded by mother until independent or well through summer, then leave mother's nest.

Although this spider spins silk, it makes no web for capturing prey. It moves rapidly in any direction; when necessary, leaps into air to capture its prey, "letting out a line" of silk until it is ready to stop, then climbs back up silk to place it left. Hides in silken nests in winter.

Amusing and harmless resident of rooms in which we live. Obviously favors dryness, sunny spots, and warmth; active in daytime rather than at night. Excellent subject for classroom study. Should be better known by all students and housewives. Makes common cobwebs that hang from ceilings.

Family Sarcoptidae

Itch Mite *Sarcoptes scabiei*

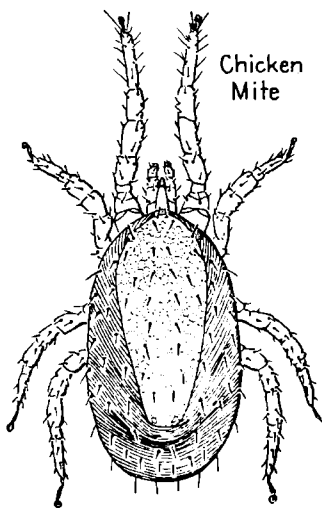
Almost too small to be seen by naked eye. Mite is white. In female, first 2 pairs of legs end in stalked suckers; in male, all 4 pairs have suckers; fourth pair in female tipped with long bristle. Size about $\frac{1}{50}$ in. long and $\frac{1}{48}$ in. wide.

Other related species also cause such skin diseases as scab and mange. About 100 known species in group, of which 13 are American. This species parasitic on man and hogs. Common where cleanliness is not observed, with female laying her eggs under skin of host.

Female makes irregular burrows under skin, laying oval eggs, singly, in rows of about 22–24. In about 7 days eggs hatch into little mites whose explorations cause further irritation. Time from eggs to eggs about 4 weeks, though cold weather may extend this period considerably. May live away from host.

Position under skin makes it practically impossible to remove pests mechanically, and attempts to do so only spread infection. Others may be infected by contact with clothing, towels, bed clothing, or anything handled by infected person. No significance in the name "7-year itch," as infection need not be tolerated.

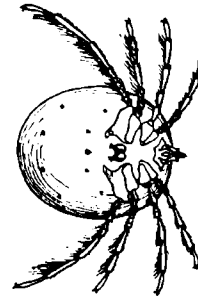
Infected person should be bathed and rubbed thoroughly in hot water and green soap, followed by bath in hot water and by applications of sulfur ointments which should remain on body several hours. Infections should be handled promptly particularly where persons come in contact with others in public places.



Chicken
Mite



Texas-fever
Mite



Fresh-water
Mite

PHYLUM ARTHROPODA. CLASS ARACHNOIDEA
Order Acarina. MITES

Family Gamasidae

Chicken Mite
Dermanyssus gallinae

Flat, reddish, pear-shaped, about $\frac{1}{32}$ in. long and slightly more than half as wide, with hind legs not reaching to rear end of body. Female with long piercing mouth parts. Male with pincer-like mouth parts. Body not conspicuously constricted at any place. Young with 3 pairs of legs like insects.

One American species of genus, but 18 American genera in family. This genus found almost exclusively on birds, though this species may live, at least temporarily, on humans, dogs, cats, horses, or other domestic animals. Relationship is of course as parasite on host.

Elliptical pearly white eggs, laid from 3-7 at a time, with a total of 25-35 during 8 periods. Eggs laid in cracks near roosts or in nests; hatch in 2 days into small mites, which, after third molt, become adult. Time from egg to egg may be 7 days; individuals may live 4 months.

Crawls about roosts and birds, sucking blood, most commonly at night. Hides easily because of smallness, flatness, and other qualities. In family are some mites which live independent of hosts; some which are parasitic on insects as well as on warm-blooded animals; some which use insects primarily for transportation.

May be kept in control by scrupulous cleaning of roosts and nests, using crude petroleum mixed with kerosene. If too abundant, may kill chickens or so weaken them as to injure their productivity. May kill young of wild birds which use same nest succeeding seasons.

Family Ixodidae

Texas-fever Tick
Margaropus annulatus

Female length, $\frac{1}{2}$ in.; body elliptic to rectangular, yellowish or slate-colored. Male length, $\frac{1}{10}$ in.; body oval, brown. Eyes present but often indistinct. Young, $\frac{1}{32}$ -in. "seed ticks." Plate around spiracle, round in this genus; comma-shaped in genus *Dermacentor*, which includes common wood tick and spotted-fever bearer.

On cattle or ground, particularly through Southern states. Commoner in fields where cattle or other hosts have lived constantly. Numbers can be kept down by dipping cattle periodically. Disease caused by tick parasite may prove fatal to cattle or may merely prevent them from producing flesh, young, or milk.

Mature female leaves cattle host, drops to ground, lays over 5,000 eggs which hatch in 15 days to over winter. Young ticks climb vegetation, attach selves to passing cattle and, in this species, pass all molts on cattle. May infect cattle with the sporozoan *Babesia bigemina*, which causes Texas fever.

Infected adults can pass sporozoan through eggs to young, which may infect another host; hence Texas fever is not contagious between cattle but is spread by ticks. Ticks of all sorts should be removed from humans, cattle, and other hosts to avoid possible infection.

Controlled by pasture rotation or by dipping cattle in crude petroleum or arsenical mixture. Keeping cattle out of field for few months usually starves all ticks and makes field again suitable for pasturage. Usually 4 lots used, moving cattle before new eggs hatch. Ticks should not be crushed but can be forced to free themselves by applying match or alcohol to exposed end. Loss may reach 60 million dollars a year.

Family Hydrachnidae

Fresh-water Mite
Hydrophantes ruber

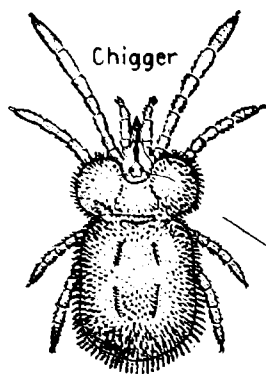
Body $\frac{1}{10}$ in. long, almost round in outline, with swimming hairs on last 3 pairs of legs. Body soft, with chitin plate around median eye on top surface; in this species, no other chitin plates above. Red or brown or intermediate in color, sometimes rather brilliant, sometimes dark.

Common, particularly in spring in and near woodland ponds, or frequently in some stage on insects flying about. Some 17 species in genus and 700 American species in family, with many variations. Eyes and plates are characters used in distinguishing many.

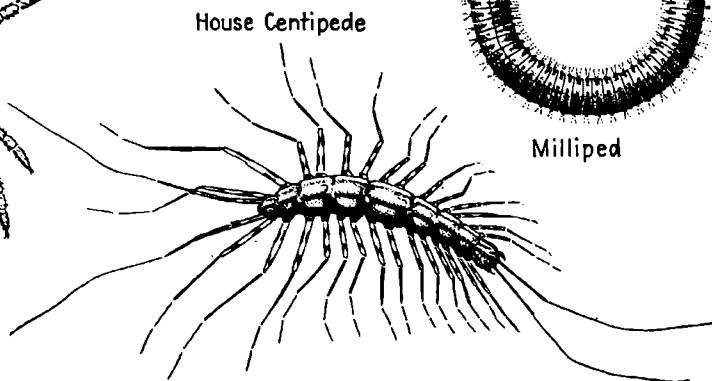
Eggs may be laid on plants, stones, or animals. At first, young have 6 legs; pass through complete metamorphosis before reaching maturity. Larval stages leave water and are parasitic on aerial insects; adults return to water to breed. Related clover mite and red spider may live wholly out of water.

Usually burrow into animal or other material which they eat, but frequently conspicuous on surface because of red color. Some are specific as to host while others are not so particular.

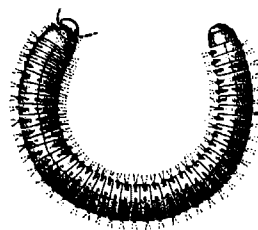
These mites are of little economic importance normally, but on cultivated plants may be serious pests. Flowers of sulfur or kerosene emulsion used as spray provides most common control practice. Some are bad pests in green-houses and on house plants, as well as on garden truck crops.



Chigger



House Centipede



Millipede

PHYLUM ARTHROPODA

CLASS ARACHNOIDEA

Order Acarina Family Trombidiidae

Chigger

Trombicula irritans

Minute harvest mite with greater constriction forward of middle of body than most others of group. Immature form has only 5 hairs on dorsal plate. In immature and pestiferous stage, it is small enough to make its way through meshes in ordinary cloth used in clothing.

Closely related to "red spiders." About 4 American genera and 30 species, in none of which are adults parasitic. This species occurs from New York to Minnesota and Kansas and through South, but close relatives extend ranges, particularly westward in South. Found on vegetation and then on animals.

In northern part of range, larvae appear in June and disappear by October. They attach themselves to animal hosts that brush against plants on which they lie in wait. They do not burrow under skin but attach themselves and cause intense itching and pink or red spots. Usually leave host in 1-7 days.

Known to live as parasites in larval stage on man, mice, rats, rabbits, prairie chickens, quail, toads, box turtles, and snakes. Humans attacked severely may run a slight temperature and develop certain nervous diseases due to inability to sleep. Japanese chigger causes Japanese river fever, fatal to 33% of victims.

Most species easily kept off by soaking garments in $\frac{1}{4}$ lb. of naphtha soap and $\frac{1}{2}$ lb. of powdered sulfur in 1 gal. of hot water; with less trouble, by dusting powdered sulfur onto ankles, waistline, and other places of contact with clothing before going afield. Sulfur or carbolic salve gives some relief. A great pest attacking man and beast as do chiggers of Europe.

CLASS MYRIAPODA (One pair of antennae present)

Order Chilopoda Family Scutigerae

House Centipede

Scutigera forceps

Members of order Chilopoda have reproductive pore near rear end, while Diplopoda have it forward. Chilopods also have only 1 pair of legs to a segment, instead of 2. This species has a body about 1 in. long which is light brown with 3 dark longitudinal stripes. Last pair of legs nearly 2 in. long.

Common in United States from New England through central and western states, but more common in South. Favors damp places such as cellars. While members of this family have 15 pairs of legs, those in related family Geophilidae may have 173 pairs. Some 800 species of centipedes, among largest being a tropical form 1 ft. long.

In Geophilidae and Scolopendridae, young have all their legs at time of birth; in Lithobiidae and Scutigerae, they have only 7 pairs at this stage in development. Centipedes not normally social animals. Species here considered most delicate and difficult to collect whole.

Food largely insects such as cockroaches captured and killed by poison forced through opening in special poison-bearing claws. Will kill many small animals but is not dangerously harmful to man, though it may be painful. Treat by bathing in ammonia solution and retarding blood flow.

Some tropical species are dangerous, but most temperate zone species are highly useful as insect destroyers. The small $\frac{1}{4}$ -in. garden centipede may be a pest of asparagus and garden flowers. It can be controlled by winter flooding of field for 3-4 weeks, treating soil with weak bichloride of mercury, or fumigating soil with paradichlorobenzene.

Order Diplopoda Family Julidae

Millipede, Thousand-legs

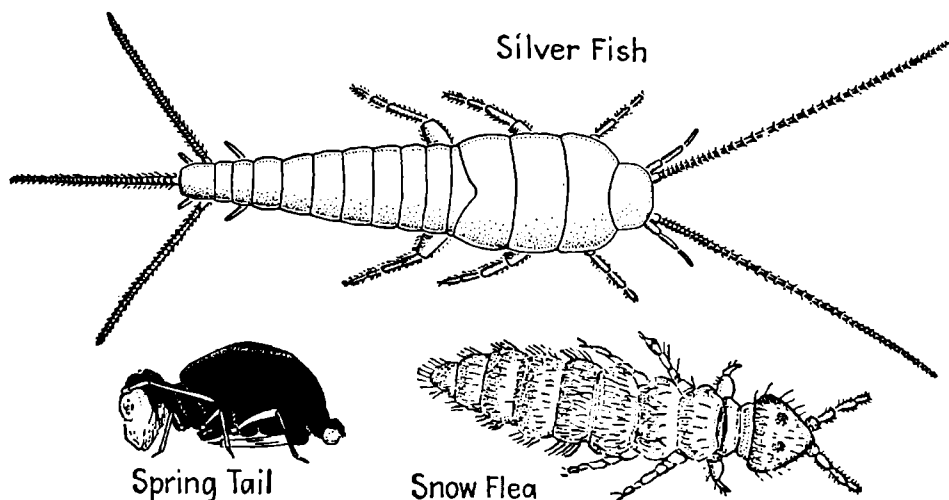
Julus sp.

Members of order Diplopoda have 2 pairs of legs to most body segments. Ventral plates of *Nemasoma* free; body segments number 35-45 in $\frac{1}{2}$ -in. *N. minutum*. In *Julus*, only 2 forward ventral plates are free. 30-35 segments in $\frac{1}{2}$ in. *J. virgatus*; 52 segments in $\frac{3}{8}$ in. *J. venustus*. Mating legs of male hidden.

Common in dark moist places such as meadows and gardens, in decaying food materials. Some 125 American species in 8 different families, with 50 species in family here considered. Members of family lack sucking mouth parts, have over 30 body segments, have stink glands, and all legs on seventh segment are of mating type.

Mating effected with assistance of legs on seventh segment of male. Eggs laid in cluster in damp earth. When young first hatch, in about 3 weeks, they have only 3 pairs of legs; as they go through successive molts number increases until commoner species have 30 or more pairs.

Food usually decaying plant material but, in wet weather particularly, may feed on roots of living plants. Protection effected by curling so that hard plates of back cover leg-bearing surface. Stink glands along sides of body, some bearing prussic acid, make animals obnoxious to prospective enemies.



PHYLUM ARTHROPODA. CLASS INSECTA

Insects have bodies divided into head, thorax, and abdomen. In adults, head bears 1 pair of antennae and thorax commonly 3 pairs of legs and 1-2 pairs of wings. Insects are air breathers when adult. More than 650,000 known kinds.

Order Thysanura

Wingless, with 11 abdominal segments and usually 2-3 slender segmented caudal appendages. Chewing mouth parts.

Family Lepismidae

Silver Fish, Fish Moth
Lepisma saccharina

About $\frac{1}{4}$ in. long. Glistening, scaly, silvery white with yellowish tinge; 2 conspicuous appendages in front and 3 behind. Active runners. Related firebrat *Thermobia domestica* more dusky. Bodies of both flattened from top to bottom.

Found on floors, tables, and shelves, particularly where there is starched material such as clothing or books or glued areas. Favor dry areas and live where little seems available for food until books begin to shed their bindings and labels and clothing to show holes.

As in succeeding orders young and adults resemble each other, differing chiefly in size. Metamorphosis such as is common in higher orders of insects is accompanied by much less pronounced changes.

Food either plant or animal material, although some authorities contend that only plant material is eaten. It probably varies with different kinds of Thysanura. Some species that live in dark places have lost their eyes. They also differ considerably in requirements of temperature and humidity.

May cause serious damage to books, clothing, carpets, and to museum specimens, particularly if storage rooms are damp. Control is by poisons. Card baits are covered with a 3-5% powdered arsenic and starch paste and placed where insects are known to be, or boric acid powder is sprinkled in their haunts.

Order Collembola

In these wingless insects, young resemble adults. 6 abdominal segments. On first are pair of organs useful in walking on smooth surfaces. On third are usually short appendages that hold springing organs borne on fourth. Springing organ hurls creature into air. None over $\frac{1}{8}$ in. long.

Family Sminthuridae

Springtail, Garden Flea
Sminthurus minutus

Body shorter and more compact than in snow fleas, and with a more obvious constriction between first and second thirds. Jumping ability well-developed, as is ability to cling to smooth surfaces. Appear comical when seen under microscope.

These relatives of snow fleas live in drier areas than do other Collembola. One species, *Sminthurus hortensis*, is common on leaves of many garden plants, such as turnips, cucumbers, and cabbages, particularly when they are young.

Young resemble adults, as in other members of order. Little seems to be known about their general life history and habits.

Food plant material. Amount of activity is modified considerably by amount of moisture available. These animals have tracheae, the openings of which are on sides of neck. They do not breathe through body surface as do snow fleas.

Where these insects are sufficiently abundant to be pests, they may be controlled by bordeaux spray mixed with pyrethrum powder. This must be applied thoroughly to all surfaces, as insects may congregate in great numbers in relatively inaccessible places.

Family Poduridae

Snow Flea
Achorutes nivicola

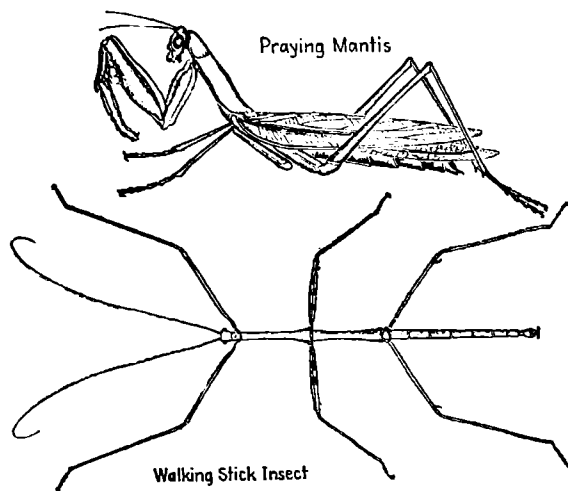
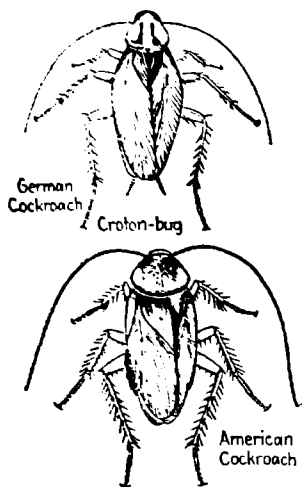
Snow fleas belong to suborder Arthropleona, all members of which have long rather slender bodies in which segments are conspicuously distinct. In some members of family, leaping organ is absent.

These insects live in, on, or close to water. *Achorutes nivicola* is often common in great numbers on surface of snow, where it appears like jumping grayish dot. On fungi there are frequently great numbers of *A. armatus*. On surface of standing fresh water is related *Podura aquatica*; and along tide marks, *Anurida maritima*.

Young like adults, as in other members of order, but little is known about their general life history. They seem to be seasonally abundant, have obvious environmental preferences so far as amount of sunlight is concerned.

Food probably mostly plant material. Since there are no true breathing organs, animals doubtless breathe through surface of body. This may explain their sensitiveness to varying climatic conditions.

Normally these insects are of little economic importance, though some of their relatives may be pests of certain garden plants or may swarm around maple-sugar buckets and possibly do small amount of damage.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Orthoptera

Family Blattellidae

American Cockroach *Periplaneta americana*

Length to $1\frac{1}{2}$ in.; one of our largest cockroaches. Wings long and well-developed. Antennae may reach beyond end of extended hind legs. Brown; wings usually lighter in color than body.

Among most primitive of insect groups, abundant in Carboniferous period. This species widespread in United States, most abundant in central and southern portions; competes for disfavor with German cockroach or Croton bug, *Blattella germanica*, which came into prominence in New York City when Croton Dam was built. Oriental cockroach, *Blatta orientalis*, common in Europe and in eastern and southern United States.

Female lays reddish-brown discs of eggs numbering between 200-300. Eggs are stuck to floors and cracks, and in good temperatures hatch in about 70 days into young cockroaches that resemble their parents except that they have shorter wings. It may take a year in this species for development from egg to adult, but other species have a shorter cycle.

Food any organic material, particularly foodstuffs, bookbindings, filth, or, in some cases, even nails of human beings. Filth and partly digested foods are expelled onto good foods, spoiling them. Generally cockroaches avoid light, favor moist areas, and are likely to thrive in large numbers of their kind.

Serious enemies of foodstuffs and destroyers of books, carpets, paper, and sometimes of clothing. Because they may eat same foods as man, have been used as experimental animals in studying effects of different diets on development through many generations. Serve as scavengers. Control by fumigation, cleanliness, traps, and powdered arsenic baits.

Family Mantidae

Praying Mantis *Mantis religiosa*

About 2 in. long. Green or brown. Forelegs used in grasping prey; held often as though in prayer, with fore part of body bent upward, head twisting from side to side. Antennae erect and short. Hind legs used in walking and leaping. 4 well-developed wings permit slow, extended flight.

European mantis, native of Europe, well-established in eastern United States. Known as rearhorses, mule killers, devil's horses, and soothsayers. Native, smaller mantis of eastern United States is *Stagmomantis carolina*. About 20 species in country. Chinese mantis *Paratenodera sinensis*, has established itself in Eastern States.

Large straw-colored egg masses, of to 1,000 eggs, are laid in fall on boards, weeds, or buildings. They hatch in May or June into little mantids that resemble parents except for absence of fully developed wings. Young grow slowly, acquiring wings and maturity in August. Egg masses often 1 in. long, often hatched indoors.

Food largely flies, grasshoppers, and other insects. Female frequently eats her smaller mate after breeding act, or even before if she is hungry enough. Prey is grasped and held by spine-laden forelegs, eaten at leisure with a most comical display of apparent indifference.

All exceptionally useful destroyers of other insects and should be encouraged in gardens where they may play an important role in insect control. Larger species widely introduced. Egg masses are collected and sold for establishment of colonies. Read Fabre's description in "The Life of the Grasshopper."

Family Phasmidae

Walking Stick *Diaperomera femorata*

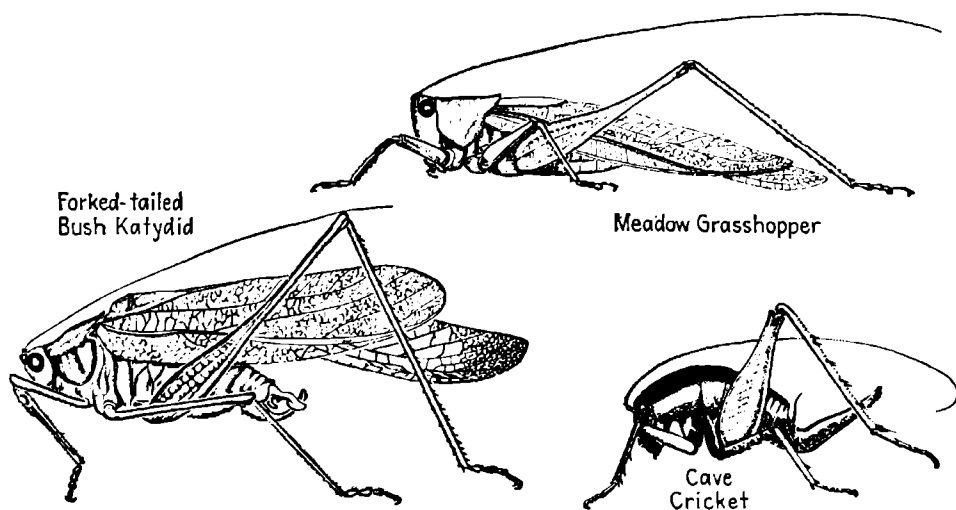
Length, over-all, to 4 in. or more, with diameter of body only about $\frac{1}{4}$ in. at most. 6 legs are in widely separated pairs and may be held so that whole resembles a green or dead stick, since color may be green or brown. Legs and antennae about equal in length. Eyes small and to front.

Relatively common in United States, except in more southern states. About 20 species found in country and group is mainly tropical, where it is represented by over 600 species; some over 16 in. long; one is the famous tropical leaf insect, *Pulchriphylium scythe*.

Eggs white with a black stripe; dropped to ground from trees in fall, sounding like rain, hatch in spring. Young resemble adults in shape but not in size. Full size may be attained in 6 weeks after hatching. In some species, eggs do not hatch until second spring after they are laid.

Food largely foliage of trees of forest. Sometimes destruction of leaves is complete and hence serious. Activity is greatest at night. No noises are made. Since there are no wings, locomotion is by walking, though some species leap and others run. Individuals may remain practically motionless during daylight.

May be serious pests to trees but entirely harmless to man. When abundant as pests, they are sometimes controlled by use of a sprayed stomach poison. Food is chewed, not sucked. Superficially resemble water scorpions of fresh-water ponds, but these suck their food.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Orthoptera. Family Tettigoniidae

3 members of this family are shown. For most part, these grasshoppers are green, have long hind legs useful in jumping, long slender antennae, with organs of hearing on the forelegs and, except in the mole crickets and sand crickets, females have long curved blade-like ovipositors with which they lay eggs in ground or in plant leaves or stems. Important subfamilies include false katydids, including *Scudderia*; true katydids; meadow grasshoppers, including *Orchelimum*; cone-headed grasshoppers; shield-backed grasshoppers; leaf-rolling grasshoppers; cave crickets; and sand crickets.

Forked-tailed Bush Katydid
Scudderia furcata

Length about 2 in. over-all. Forewings nearly uniform in breadth throughout length, differing in this respect from angular-winged katydid, *Microcentrum*, which has a short, abruptly up-curving ovipositor, and the oblong-winged and the round-winged katydids, *Amblycorypha*, which have long, curved ovipositors.

Scudderia, in different species, is found throughout United States and most of Canada, but mostly east of Great Plains, living on bushes. True katydid, *Pterophylla*, is found in trees, usually in restricted colonies, but throughout United States east of Rockies.

Scudderia lays flat eggs, $\frac{1}{4}$ – $\frac{1}{2}$ in. long, in rows on leaves in late summer. These hatch in following season and young resemble adults except for absence of wings. No pupal stage.

Food leaves of plants on which insect is found. *Scudderia furcata* gives a soft, high, oft-repeated *zeep, zeep, zeep*, from bush or tree; *S. curvicauda* calls *bzrwi* in day and a shorter *tschw* at night; *Amblycorypha* gives a shrill *shrie-e-e-k*; *Microcentrum* calls a high, repeated *tzeet-tzeet-tzeet-tzeet-tzek-tzek-tzuk-tzuk*.

Economic importance not great.

Meadow Grasshopper
Orchelimum vulgare

Length about 2 in. from tip of wing to tip of head. Slender, pale green, with long slender antennae. Head slender, pointed. Eyes relatively small and near front of head. *Conocephalus* is smaller and more slender and commonly with straighter ovipositor.

Found in moist pastures and meadows, usually among grassy plants, with *Orchelimum vulgare* ranging from Rocky Mountains to Atlantic Coast and generally common. Not commonly found high above the ground, even though suitable food might be available.

Eggs laid in plant tissues with the aid of curved ovipositor; hatch in spring. Young resemble adults in general form but do not develop wings until maturity is reached by early summer. No pupal stage.

Food mostly grasses. Front wings of males differ from those of female. In male, left front wing overlaps right and by means of scraper causes rasping sound, due to vibrating membrane. These sound-producing organs are on wings close to body. Ears of Cone-headed grasshoppers appear as 2 vertical slits on forelegs.

Meadow grasshoppers are not commonly listed as being serious pests, as compared with those described on next page.

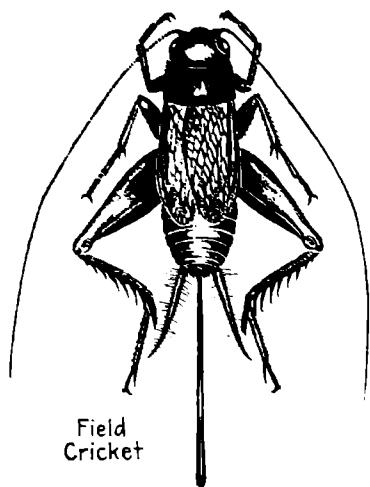
Cave Cricket
Ceuthophilus gracilipes

Wingless. Pale brown or dirty white, with brown spots. With high arched back and remarkably long hind legs and antennae. Body short and thick-set for a grasshopper; in female, terminates in curved sword-like ovipositor. Lacks the sway-back of related sand cricket.

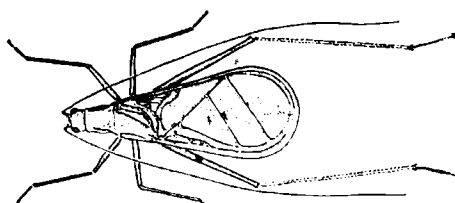
Common in cellars and moist caves, or in woods, gorges, or wells. Usually where there is little light. At least 12 species of cave crickets or camel crickets in the United States. Related sand crickets are found on the Pacific Coast.

Since these crickets have no wings, they can make no sound. Eggs laid in late summer, probably in ground, may hatch in fall but more commonly in spring, into young nymphs that resemble parents.

Food meat, fruit, vegetables, or almost anything organic and available. While cave crickets are not ordinarily considered of great economic importance, related Jerusalem cricket and western cricket, *Anabrus purpurascens*, may be serious pests to crops in West, sometimes reaching plague proportions and eating even their own kind.



Field Cricket



Snowy Tree-cricket



Lesser Migratory Locust

PHYLUM ARTHROPODA. CLASS INSECTA Order Orthoptera

Family Gryllidae

Field Cricket *Gryllus assimilis*

Length over-all of these crickets about 1 in. Female (illustrated) with long slender ovipositor, which is lacking in male. Smaller brown cricket, *Nemobius*, is possibly more common. It is $\frac{3}{4}$ in. long; brown, with 3 darker abdominal stripes.

Field crickets are found in dwellings, fields, pastures, gardens. Cricket on the hearth or house cricket, *Gryllus domesticus*, is slender pale yellowish brown with $\frac{3}{5}$ -in. body native to Europe but has been established in America. Family includes also mole crickets.

In late summer or fall, female lays several hundred eggs, singly or in masses, in holes in ground. Eggs hatch in fall or spring. Those hatching from eggs in July may mature by mid-August. Immature crickets resemble adults but lack developed wings. No pupal stage.

Food plant or animal matter, but mostly plants. Males begin singing by wing rubbing about June and continue through August, purpose apparently being to defy other males. Chirp loudest when weather is brightest and warmest. Males will fight each other if confined, chirp pitch rising.

May destroy grass, clothing, food, and other materials. May be controlled by baits, such as sliced potatoes poisoned with Paris green or partly opened jars containing sweetened vinegar. Another bait is made of 1 lb. of Paris green or white arsenic to 25 lb. of coarse bran and 2 qt. of cheap strong molasses.

Snowy Tree Cricket *Oecanthus niveus*

Slender, pale green. About $\frac{1}{2}$ in. long, with long antennae. Female with wings closely wrapped about the body. Male with more slender body and with wings broader and relatively free and, of course, without long ovipositor. Male secretes at base of wings a liquid that female seems to enjoy eating.

Commonly found singly or in pairs on trunks of trees or shrubs in late summer, with several species covering United States and Canada. Common species include the snowy, the narrow-winged, the black-horned or striped, the four-spotted, and the broad-winged, all of which are good singers.

Male sings. Female may approach and feed on liquid on back. Mate. Eggs deposited on bark or stems such as raspberry canes, 40-50 together; hatch in early summer into little crickets that resemble parents except for wings. Reach maturity by midsummer. Killed with advent of cold weather.

Generally most active at night. Males fly readily and give calls in unison with other males. Add 37 to number of times males call in 15 seconds to get approximate Fahrenheit temperature. Calling is done during night of warmer months and is described as "slumbrous breathing." Amply protected from enemies by coloration.

Young and old feed largely on plant lice and so are essentially useful to man. One species, *O. nigricornis*, may injure raspberry canes by laying eggs too closely together on stems, but most other species do little if any damage and much good, so are worthy of protection because of their pleasing music and useful food habits.

Family Acrididae

Lesser Migratory Locust *Melanoplus mexicanus*

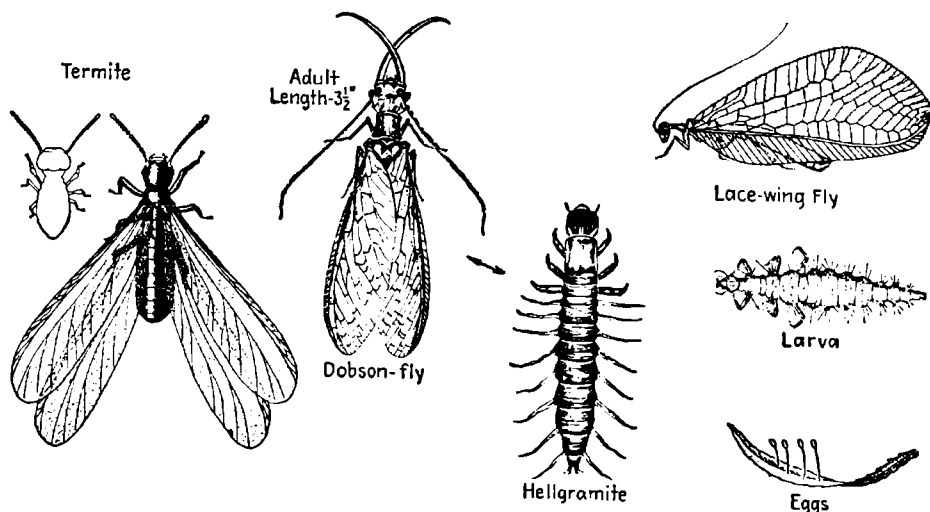
Length about 1 in. Yellow or tan, with dark bars across hind legs. Forewings grayish, extending beyond end of body, with a few dark spots near middle. Female with abdomen as illustrated. Antennae relatively short. Hind legs suitable for jumping great distances, even without help of wings.

Wide distribution in North America. Found in fields and meadows. Often serious pest in East. Commonly found with red-legged grasshopper, *Melanoplus femur-rubrum*. The Rocky Mountain locust, formerly known as *M. spretus*, is merely the long-winged migrating phase of *M. mexicanus*, which until recently has been known as *M. atlantis*.

Mates and in fall female lays eggs underground, in clusters of 12-80, in 2-in. burrows. Eggs about $\frac{3}{16}$ in. long, like taper-ended cylinders; hatch in spring into nymphs that shed skins 5 times before attaining maturity and wings. No pupal stage.

Food almost any plant material, often serious pests to crops. Some grasshoppers give weak sounds. Carolina locust of roadside displays yellow-bordered, black hind wings, and the cracker locust gives a clicking sound, possibly in courtship. Eardrums or membranes are on sides of body behind wing bases.

Late fall plowing may destroy eggs in ground. Rolling of fields may kill young before they have developed wings. Hopperdozers dragged across fields, and ditches dug through or around them, provide some control. Baits may be used. Possibly some use of dried grasshopper bodies as chick or fish food may make capture profitable and offset losses caused.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Isoptera Family Termitidae

Termite

Reticulitermes flavipes

Social, colonial. 4 castes: first, reproductive caste; both sexes winged, black or chestnut, functional eyes, with wings over half their length beyond end of body. Second, reproductive caste; both sexes pale, eyes partly pigmented, wings short wing buds. Third, reproductive caste; dirty white, blind, rarely mature sexually, workers. Soldiers wingless, rarely lay eggs.

Most species tropical, though some live in temperate regions. In United States live in hidden nests, usually in wood of buildings or furniture, though some may build in living trees. Some build covered ways from nests to food or other necessities. Some in Africa build mounds 12 ft. high.

First reproductive caste sheds wings after mating flight and female acts as egg-laying queen. Should she die, her place taken by one or more second reproductive caste queens with small egg capacity, or eggs may be laid by queens of a third reproductive caste, or even by female soldiers or workers. Nymphs cared for by workers. Colony defended by soldiers.

Food of this species, mostly wood and other plant material. Differentiation in members of castes comes early; interpretation of what establishes an individual in one caste or another differs with authorities. Certainly early stages of third reproductive caste and of workers appear to be almost identical.

Very destructive to wooden things; great care must be taken to control establishment of colonies. May eat interior out of a wooden table, leaving only thinnest shell that may collapse suddenly. Same damage may be done to wooden foundations of buildings. Wood in contact with earth must be protected from attack.

Family Sialidae

Dobson, Hellgrammite

Corydalus cornuta

Neuroptera have 4 finely netted membranous wings. Dobson flies have wingspread of over 5 in. Adult males have long slender crossed jaws, while females have shorter stouter jaws. Larvae aquatic, strong-jawed, breathing through gill tufts at base of abdominal segments. Fearsome-looking in most stages.

Larvae live in moving water and adults fly near it, often attracted by lights. At least 6 species of family found in United States. Smoky alder fly is about 1 in. long; other common members of family usually larger; one, *Nigronia*, has conspicuous white-banded black wings.

Mates outside water. Eggs laid in white blotch, sometimes 1 in. across, on objects over water, about 2,000 to a mass. Hatch into larvae that drop to water and develop for about 35 months; then leave water to pupate for 1 month in cell, under cover, on bank. Because of long aquatic larval stage, must live in permanent streams.

Food almost exclusively aquatic animals caught and held by strong jaws that are able to inflict painful bites on humans. Hold on tenaciously. Protection effected by aquatic habitat and by position under stones. Fish are greatest enemies, and they are enemies to young fish.

One of best of bass baits in larval stage and, as such, is worthy of protection. Larvae may be destructive in fish hatcheries, but are rarely found there. Because of appearance and congregation around lights, they frighten people. Many are killed needlessly. Popular subjects of study in entomology classes because of size and primitive nature of larvae.

Order Neuroptera

Family Chrysopidae

Lacewing, Goldeneye

Chrysopa oculata

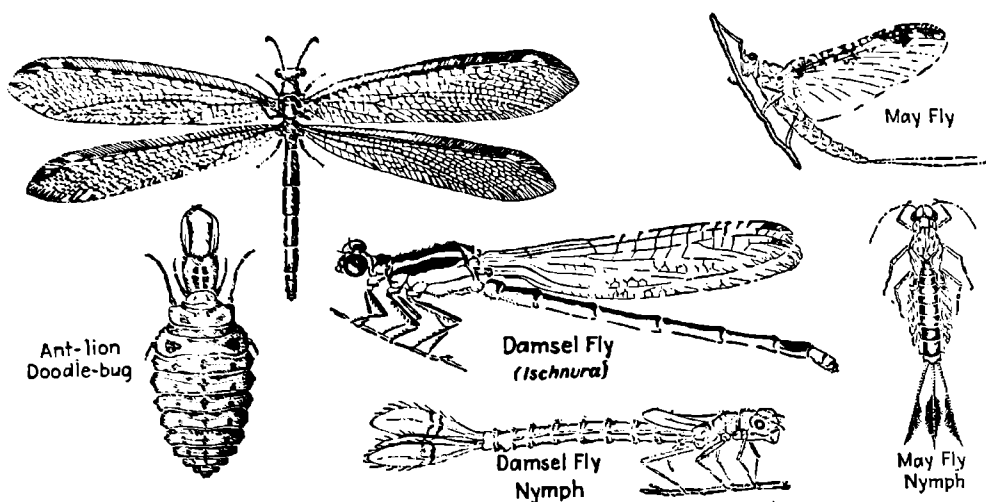
About 3/4 in. long; antennae are long and slender. Pale green, delicate, golden-eyed, lacy-winged, with some black markings on head. Abdomen slender. Odor most offensive when insect is held close to nose. Rather awkward fliers. Larvae as shown, active.

About 60 species of lacewings live in United States, most of them being found on plants in fields, gardens, or orchards. Adults are attracted by light and are commonly found on screens and on radiators and windshields of automobiles. Eggs and larvae occur on leaves and stems of plants.

Eggs placed on plants at tips of erect, slender stalks. Larva hatches in about 5 days, crawls down stalk seeking animal food and its brothers and sisters safe on near-by stalks. Larval stage about 2 weeks, with skin shed twice. Cocoon papery, thick, egg-shaped, about 1/4 in. long. In summer, pupates about 26 days; may winter in cocoons.

Food largely plant lice, on which larva feeds voraciously. Adult may live through winter, but rarely. Egg laying begins shortly after emergence and mating. One female known to lay 617 eggs during short life as adult. Apparently detects food by feeling rather than by smelling or seeing. Odor may be protective quality.

Highly useful as destroyer of plant lice, both in larval and adult stages. Single larva may destroy 200 aphids in 20 days. Called "green flies" though they are not true flies. Should be protected and encouraged in every way because of food habits.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Neuroptera Family Myrmeleonidae

Ant Lion, Doodlebug *Myrmeleon immaculatus*

Adult appears somewhat like a damselfly but has fair-sized knobbed antennae. Length about 1½ in. Wings 4, fore pair slightly larger than rear. Abdomen long, slender, or about ¾ total length of insect. Rather awkward flier. Larvae like small ovals, with extraordinarily long jaws.

Widely distributed in United States in sandy areas, but more particularly in dry parts of South. About 60 species in United States, belonging to 11 genera. About 200 Neuroptera in United States and about 1,000 in world, with several known as fossils.

May require 1-3 years to reach maturity. Larva or doodlebug lives at base of self-made pit in sand, into which prey may fall, only to be caught by larva at base and eaten. Larva's jaws are hollow and prey's juices are sucked in. A globular silk sand-covered cocoon size of a large pea covers pupa.

Food largely ants caught in pits. Once an ant enters pit, larva at base keeps it tumbling by burling sand at it and undermining its footing. Legs and large body of larva serve to anchor it against struggles of ant. Larva moves backward more readily than forward.

Useful enemies of harmful ants and most interesting insects in larval stage. Children like to bait doodlebug larvae with grass stems and watch larvae hurl sand when sufficiently disturbed. No ant lion is harmful.

Order Ephemeroidea Family Ephemeridae

May Fly *Callibaetis* sp.

Adult thin, delicate, with wings held over back when at rest. Usually with 3 but sometimes with 2 long delicate "tails"; front pair of legs held conspicuously forward. No pupal stage. Nymphs aquatic, with 2-3 tails; gills on sides of fore part of abdomen, but variable in different species.

Some 100 known species of May flies in United States; at least 500 in world; many fossil species. Appear in great numbers in and near bodies of fresh water, particularly about rivers and streams, nymphs living under water.

Adult May flies live only a day or two, mating in flight. Females drop eggs or place them under water, 500-1,000 per female. Eggs hatch and develop through sometimes 21 molts, taking from 6 weeks to 3 years to complete a generation. Unlike other insects, may molt once during adult life, even though this stage may last only a few hours.

Nymphs feed chiefly on plant material, which they chew. Adults eat little or nothing, as their mouth parts are mostly useless. Possibly some May-fly nymphs are carnivorous, but these would be in minority. Some nymphs burrow in mud; some cling to stones; some are almost free-swimming.

Unquestionably highly valuable as food for fish, serving splendidly in turning aquatic plants into animal food for larger animals. Adults may seem to be pests because of numbers but do little damage. Might possibly be dried and converted into fish or bird food.

Order Odonata Family Agrionidae

Damsel Fly *Ischnura* sp.

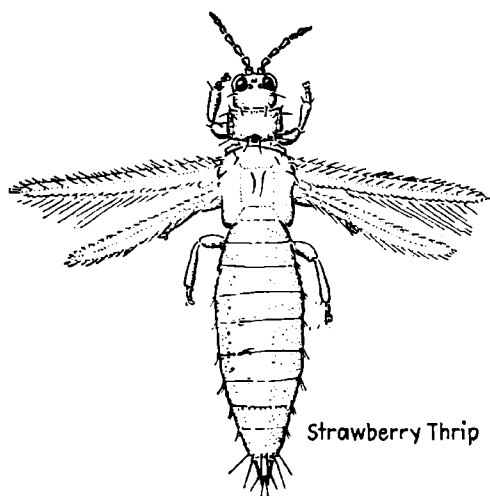
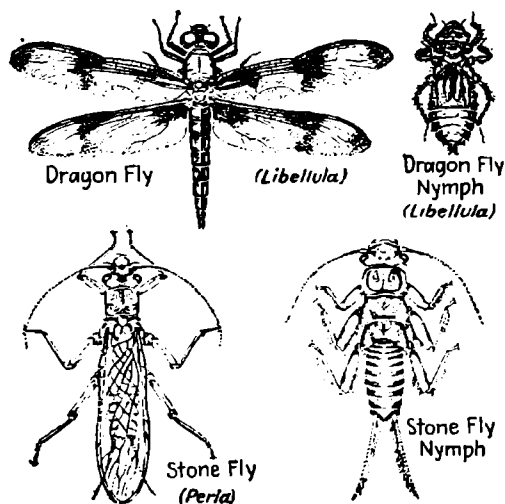
Adults slender-bodied, with 4 netted wings that fold in a vertical plane over the back when at rest. Head large and movable, with large bulging round eyes. Mouth parts suitable for chewing. Male frequently more brilliantly colored than female. Nymph aquatic, with 3 tail-like plate-like gills, and with a distinct movement from side to side.

Two American families: the Coenagrionidae, with narrow wings, and the more beautiful and brilliantly colored Agrionidae. Adults relatively slow-flying when compared with true dragonflies, as wings are moved in a more flapping style. Found as nymphs in ponds and streams and as adults near these bodies of water.

Male holds neck of female with claspers at end of abdomen and brings end of female to male sex organs on underside of fore part of abdomen. Female may lay 200-300 eggs; these are ovate, ½ in. long, and commonly inserted in tissue of water plants. Eggs hatch in 3 weeks to several months, and in going through 10-14 molts, spend 225-624 days.

Food of nymphs probably any aquatic animal that can be overcome, and of adults any insect that can be captured in flight, even though its own flight is relatively poor. Protection effected largely by hiding, though escape is usually rather easy. Summer is their adult season; sunny days their choice.

May be thought of as fish food, particularly in nymph stage, though they are competitors of fish for small animals that make up food of both. Nymphs are interesting aquarium animals for school or home, where their enmity for mosquito wrigglers may be effectively demonstrated.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Odonata Family Libellulidae

Ten-spot Dragonfly *Libellula* sp.

Adults 4-winged, with wings held horizontally at right angles to body when at rest. Wings gauze-like with fine net of veins. Abdomen long and slender. Legs medium-sized. Head large, freely movable. Eyes large and conspicuously bulging. Mouth parts, chewing. Nymph aquatic, with hinged shovel-like lower jaw that can be extended remarkably. No external gills in nymph stage. No pupal stage.

Between 5,000-10,000 dragonflies known; one fossil form has wingspread of more than 2 ft. Darners fly high; skimmers, lower; ten-spot (illustrated) at 5 ft.; amber-wing, at 6 ft.; and argias, at 2 ft.

Male has claspers at tip of abdomen and accessory reproductive organs on second abdominal segment; may hold female by neck. Female drops or places eggs in water or inserts them in mud or plant tissue. Incubation usually long, though some may hatch in 2 weeks. Usually with this species 1 brood a year, beginning in June. Transition into adult form beautiful to see. Some dragonflies of temperate regions may have 2 annual broods and some require 2 years to mature.

Food mostly larvae of other water insects but may eat tadpoles, small fish, or any other animal matter small enough to be captured. Adults feed on insects caught on wing, studies showing that most of these are probably injurious. May roost in considerable numbers together overnight but normally are not gregarious. Most are sun lovers.

Except in fish hatcheries, are probably useful insects. Always harmless to man in spite of such names as "snake doctor" and "devil's-darning-needle." As mosquito destroyers should be encouraged, and as insects of beauty are to be admired.

Order Plecoptera Family Perlidae

Stone Fly *Perla* sp.

Wings 4, rather conspicuously veined, folded along back at rest. Chewing mouth parts, in some adults, do not function. 2 diverging "tails" at rear of abdomen, reaching about to end of wings. Nymphs aquatic, with gills most commonly in pads just behind base of legs and with 2 tails. Adults fly reasonably well.

American families of the order, 4. Species known, between 2,000-3,000; mostly confined to flowing streams, with adults of different species emerging even when streams are full of ice. Adults found on land or objects near streams, or flying near streams. Nymphs cling to stones under water, where they crawl about in search of food.

Adults mate soon after emerging from water. Females drop eggs in masses in water; 200-800 eggs per female; in some species, several thousand eggs per female. Eggs hatch into nymphs that may take 1-3 years to reach adult stage. No pupal stage.

Food of nymphs, small forms of animal life captured while prowling around under water, under submerged stones and trash. Adults may eat nothing; die soon after eggs are deposited. Adults attracted to lights. Earliest species to emerge in East is *Capnia pygmaea*, which looks like a snow fly and sometimes covers posts near streams in great black swarms.

Useful as food for fishes, adults making superior trout bait, particularly if moved upstream from point at which they are emerging. A western species, *Tenopteryx pacifica*, is a serious pest to fruit-tree buds in adult stage, but other stone flies do little damage. Nymphs might be harmful in trout hatcheries.

Order Thysanoptera Family Thripidae

Flower Thrips *Frankliniella tritici*

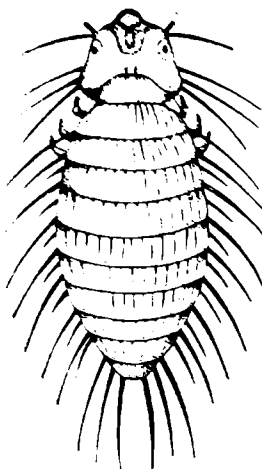
About $\frac{1}{2}$ in. long. Pale yellow to brown, with 2 pairs of long narrow few-veined wings fringed with long hairs and hence feather-like. Abdomen with 10 segments, the last cone-like in female and rounded in male. Mouth parts formed into cone attached to rear of head beneath and used in sucking. Pupal stage moderately active.

Most persons notice thrips as little slender active insects in flowers like daisies and dandelions, though they live on many kinds of plants and on many parts of these plants. Important as pests are onion thrips, flower thrips, pear thrips, citrus thrips, and others. Vary in length from $\frac{1}{50}$ - $\frac{1}{2}$ in.

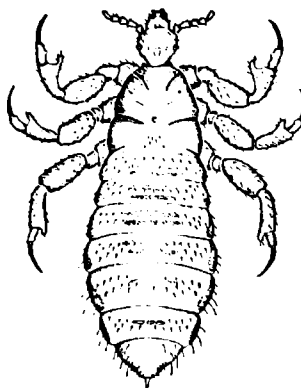
Eggs microscopic, often inserted into leaf tissue, hatch in about 4 days and then go through varying molts. Some species give birth to living young. In South cycle of this species may be completed in 12 days, while in North it may take 3 weeks or more. Young resemble adults in general form but lack wings and are paler. Wing pads appear in last two molts preceding adult stage.

Food, plant juices sucked through peculiar mouth; some prey on small insects and mites; others eat fungous spores; some take in juices of rotting wood. In South, flower thrips may be active through winter while in North it may winter as adult or nymph in protected places in grass of fields close to the ground. In general, thrips show a preference for feeding away from direct sunlight.

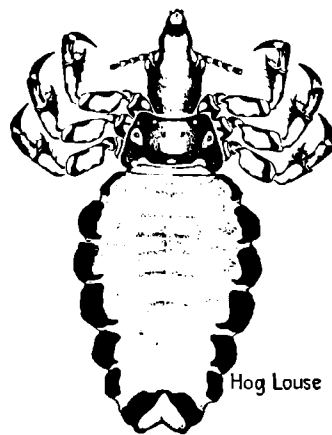
Many species are not important economically, but others are serious pests. One or two transmit virus diseases of plants. Flower thrips is controlled by a spray of 40% nicotine sulfate or kerosene emulsion (1 part in 4 parts of water), or $1\frac{1}{4}$ gal. of commercial lime sulfur and $3\frac{1}{2}$ fl. oz. of 40% nicotine sulfate in 50 gal. of water. Burning stubble may help. Rain reduces numbers.



Chicken Louse



Human's Head Louse



Hog Louse

PHYLUM ARTHROPODA. CLASS INSECTA

Order Mallophaga

Family Menoponidae

Common Chicken Louse

Menopon gallinae

Bird lice usually are from 0.1–0.04 in. long, with large heads, hard flat bodies, wingless, and always with biting mouth parts. Color usually whitish. *M. gallinae*, on chickens, is 0.03 in. long, with short legs and relatively long backward-bent hairs.

Most members of this order are found on birds, though some live on domestic mammals. Two large suborders of Mallophaga are recognized. Important kinds are *Trinoton*, goose louse; *Eriopterum*, duck louse; *Columbicola*, pigeon louse; *Lipeurus*, head louse of chickens and turkeys; guinea and peacock louse of the genus *Gonicotes*. 1,500 known bird lice.

Sexes distinct; easily distinguished in some species. Eggs laid on feathers, hatch into nymphs that resemble adults except in size. Go through a number of molts and, in few weeks, reach maturity without pupal stage. In head louse of chickens, eggs hatch in 4–5 days, maturity reached in 3 weeks.

Bird lice confined to particular hosts. At least 7 kinds on common domestic fowls. Turkey may be host to at least 4 kinds. Geese, pigeons, ducks, and guinea fowls each have many. Lice feed mostly on feathers, which they bite. Host irritated more by clinging feet than by biting.

May cause severe injury to birds. Usual control by dusting with sodium fluoride, dry or dissolved in water. If dipping is used, try 1 oz. of commercial fluoride to 1 gal. of water, with bird dipped about $\frac{3}{4}$ minutes with a few quick duckings of head. Birds that use dust are probably infested with bird lice.

Order Anoplura

Family Pediculidae

Head Louse of Humans

Pediculus humanus

Anoplura are small wingless insects with sucking mouth parts, with or without eyes, and with large abdomens and small heads. Head louse to $\frac{1}{10}$ in. long, male being $\frac{2}{3}$ size of female. Pale gray with blackish margins, head louse browner, tougher, and smaller than body louse.

Human lice world-wide in distribution and found only on man, rarely on apes. Pediculidae have eyes and live on man; tubular-headed Haematomyzidae on elephants; short, spined Echinophtheriidae on marine mammals, and blind Haematopinidae, on rodents and ungulates. "Crab" is pubic louse, *Phthirus pubis*.

Female mates 24–36 hours after reaching maturity and frequently through adulthood; may lay to 300 eggs during month she lives, ceasing only a day or so before death, usually laying 10 eggs a day. Eggs or "nits" conspicuous on dark hair, hatch in 6–30 days into nymphs that reach maturity in about 18 days after about 3 molts. Nymphs resemble adults in general.

Food blood of host, about 1 mg. per meal. Will starve in 3 days at normal temperatures of 86°F. or in 5 days at 75.2° but may survive week at lower temperatures. Die in 5 minutes at 124.9°F.; in 10–30 minutes at 121.1°F.; and in 45–60 minutes at 115°F. Eggs destroyed in 5 minutes at 128.3°F.

Bite or presence may cause infection with *Rickettsia prowazekii*, cause of typhus that killed 3,000 in England in 1 year; with *Rickettsia quintana*, cause of trench fever; and with *Spirochaeta recurrentis*, cause of relapsing fever. Controlled by DDT, by heating clothes, by washing with 2% carbolic acid or kerosene, followed by soothing olive oil and warm water.

Family Haematopinidae

Hog Louse

Haematopinus suis

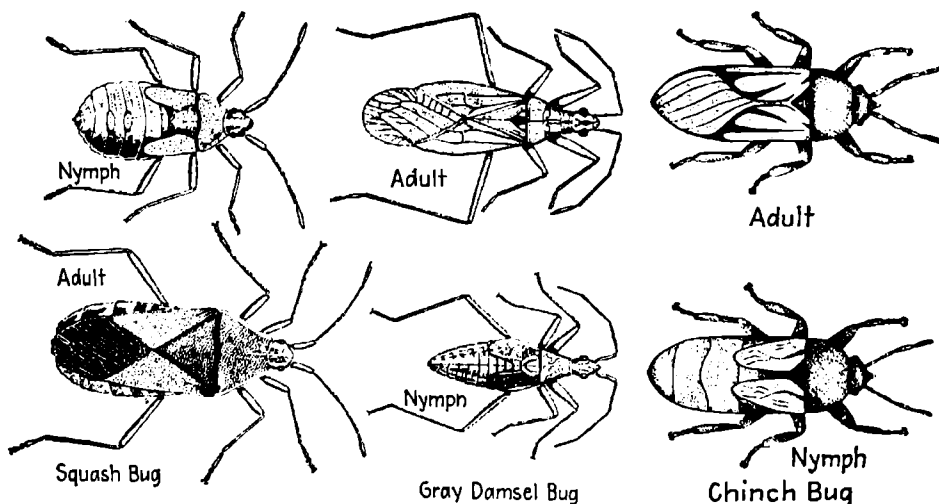
Length to $\frac{1}{4}$ in. Conspicuous black marginal band around body, with 6 long legs armed at tips with grasping hooks. Blind.

Hog louse lives on hogs, particularly on neck; sometimes on man, hiding in hair and under scales of skin. 29 genera in family that includes over half of Anoplura. Common forms include sucking louse of horses, *H. asini*; ox louse, *H. eurysternus*; goat louse, *Linognathus stenopsis*, and other lice of sheep, dogs, mice, rats, rabbits, and man.

After mating, female lays her white $\frac{1}{10}$ -in. eggs one at a time on hairs. These hatch in 12–20 days and develop through 3 molts in 29–33 days to adult form that mates and repeats cycle. Mating and egg laying begins about third day after maturity is reached and may continue through most of adulthood.

Food, blood of host taken in from 1–4 meals a day. Blood sucked with little irritation to host at time of feeding but considerable irritation later. Louse crawls about in search of food, possibly moving at about same speed as head louse of man, which can move 9 in. in a minute.

Control of infestations of lice on domestic animals necessary. Since animals lick infested areas, poisons cannot be used. Usual treatment a 15% kerosene emulsion scrubbed into skin, followed by washing with solution of 2–4 oz. of potassium sulfide to 1 gal. of water; or applying mixture of 1 part sulfur to 4 parts of lard and washing with dilute carbolic acid, 1 part to 30 parts of water.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Hemiptera

Hemiptera vary in size from minute forms to those 5 in. long. Most have flattened backs on which there are usually 4 wings in the adult. Wings with basal part usually horny and tips membranous, the hind wings entirely membranous. All suck their food and have incomplete metamorphosis. The term *bug* is properly applied only to members of this order.

Family Coreidae

Squash Bug *Anasa tristis*

Length about $\frac{3}{4}$ in. Adult dark-brown but finely mottled with gray or light brown. Wings of adult reach almost exactly to tip of abdomen; wing pads of nymph increase in size as insect approaches maturity. Antennae about equal in length to forelegs and to proboscis.

Common throughout United States on plants of squash, pumpkin, melon, cucumber, and related species, spending winter under rubbish and in protected places. Pest species in South closely related to species here considered. Adults appear in spring when host-plant leaves are developing.

Eggs laid in clusters of varying number, on underside of leaves of host plant; oval, convex, resin-brown, laid so they do not touch each other; hatch in about 10 days into reddish or greenish nymphs that change to black, green, or gray, molting 5 times to reach maturity in 4-5 weeks. Development may be more rapid in South.

Food sucked and, where numbers are large, a whole crop may be completely destroyed. If frost kills host plants before insects reach maturity, they may attack fruits but normally fruits are injured only through destruction of leaves that provide them with nourishment.

Control is by removal of trash that might provide shelter, stimulation of vigorous growth of plants to overcome damage, protection of seedlings by cheesecloth covers; or by using spray of 1 part of 40% nicotine sulfate to 400 parts of water, on nymphs. This will not control adults.

Family Nabidae

Gray Damsel Bug *Nabis ferus*

Length $\frac{1}{4}$ in. Narrow-shouldered, slender, with small head and slender legs. Antennae about length of front legs. Pale grayish-brown or yellowish, with numerous brown dots; wing veins brown. Wings of adult reach to end of abdomen, finely veined.

Common insect from Atlantic to Pacific, most commonly in leafy parts of non-woody plants relatively close to ground. It favors tall grasses and is a common sight in haymows where hay has been freshly cut. Also found in gardens and cornfields.

Winters as adult, hibernating under matted vegetation. In spring, leaves hiding and flies to feeding ground. Eggs laid in late June; female inserts them into plant tissue, laying about 60 eggs in 3 weeks; hatch in 6 or more days; nymphs resemble adults. In about 25 days and 5 molts, adult stage is reached.

Food probably exclusively other insects, captured by sudden dashes followed by a piercing thrust with beak; prey's body juices are sucked out. Aphids, leaf hoppers, plant bugs, corn-ear worms are among important kinds of insects fed upon.

Food habits entirely useful, but some plants may be injured by slits made by female during egg laying. This injury is more than offset by destruction of plant-feeding insects.

Family Lygaeidae

Chinch Bug *Blissus leucopterus*

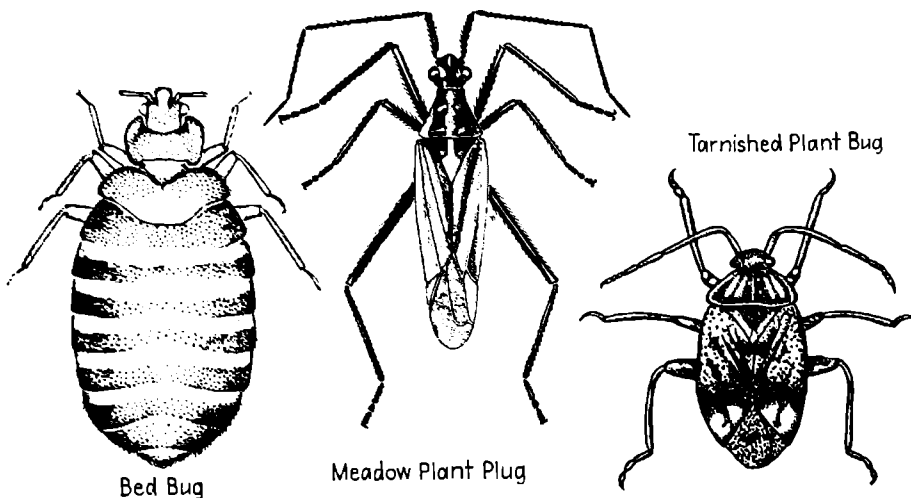
Length under $\frac{1}{4}$ in. Body black or dark gray, with conspicuous white wings, each with a single black spot. Chinch bugs of Mississippi Valley have long full-sized wings, while those of Atlantic states, and Great Lakes areas have short wings that only partly cover abdomen.

Native of tropical America that has migrated northward through Mississippi Valley, Atlantic Coast, and Pacific Coast to St. Lawrence River, Manitoba, and Washington. Most abundant and destructive in Mississippi Valley.

Long-winged form winters as adult in grass tufts and corn shocks. In spring, flies to grainfields. Each female lays several hundred eggs on ground, at base of grain plants or on roots underground. These hatch in 2 weeks into nymphs that suck plant juices during 40 days of development to adult. Nymphs at first yellow, then orange, then vermilion, with adults darker yet.

Food plant juices, with result that plants are killed. When food organisms are destroyed before insects become adult, nymphs march to new territory. Favorite foods include corn, millet, kaffir corn, and similar grains. Short-winged forms cannot fly and so must migrate by marching.

Dry weather is favorable and wet weather unfavorable for this, one of 6 worst American insect pests. Control by burning of fields, which may destroy 50-75% of adults. Fields to be protected are ringed with oil-filled trenches, or crops are sprayed with nicotine sulfate, 40% soap emulsion, or 3 oz. of soap to 1 gal. of water. Crop rotation helps.



Bed Bug

Meadow Plant Plug

Tarnished Plant Bug

PHYLUM ARTHROPODA. CLASS INSECTA
Order Hemiptera

Family Cimicidae

Bedbug
Cimex lectularius

Length about $\frac{1}{2}$ in. Flat, reddish-brown, wingless or with only wing stubs showing in adult stage. Possessed of an objectionable and strong odor. Antennae 4-jointed. Beak 3-pointed. All bedbugs are parasitic, but each kind is limited to few hosts.

Found in houses or poultry houses, in cracks in walls, floors, furniture, or in beds. American species 4 north of Mexico, including this species parasitic on man, mice, and poultry; *C. pilosellus*, a long-haired species on bats; *Haematostippon inodorus*, a long-haired species on poultry; and *Aeciacus vicarius*, in swallows' nests.

Female may lay to 200 white oval eggs, bearing a rim, in batches of 6-50, in cracks and crevices. Eggs hatch in 6-10 days; after 5 molts, in about 69 days, with an average of 8.75 meals, adult stage is reached. Completes cycle in about 7 weeks, with about 4 annual generations in warm houses.

Food is blood, preferably of man, but other animals may be used; without food, starvation may come in a year. Bite is poisonous to many people but not to others. Immunity may be developed. Known to transmit relapsing fever, plague, kala azar, and possibly leprosy by contaminated mouth parts.

Control by sulfur fumigation, 1 lb. for every 1,000 cu. ft. of space for 24 hours; by treating eggs and hiding places with kerosene, benzene or gasoline; or with 6% corrosive sublimate in water; or by heating house to 120°F. for 1 hour, or below 32°F. for 3-4 weeks continuously.

Family Miridae

Meadow Plant Bug
Miris dolabratus

Length to $\frac{2}{5}$ in. Wings narrow and folded on back when at rest. Legs long and slender. Antennae about as long as forelegs. Gray or yellowish-gray with darker markings, and with antennae conspicuously black. As in chinch bugs, long- and short-winged forms.

Particularly common among cultivated grasses. Introduced from Europe and now widely established over eastern United States from Atlantic to Minnesota and Kentucky. Closely related to more widely distributed tarnished plant bug.

Winters in egg stage. Eggs laid in fall in grass stems below point of cutting, about 1 day after mating. Female may lay 20 in a half hour, and a total of 70; may hatch next spring, go through 5 nymphal stages, averaging 6-7 days each, for a total of 30-35. Nymph resembles adult except for wing development.

Food of adult and nymph plant juices, chiefly of important grasses sucked through piercing mouth parts. Orchard grass, timothy, and fescue grasses seem to be favorite foods; since these are valuable, insect is an enemy to man's interests.

Control by crop rotation, by early and close cutting of hay, by burning over grassy fields, particularly where hay has not been cut, by fall pasturing by sheep, horses, or other close-cropping species. Best to do burning in winter so that humus will not be destroyed.

Tarnished Plant Bug
Lygus pratensis

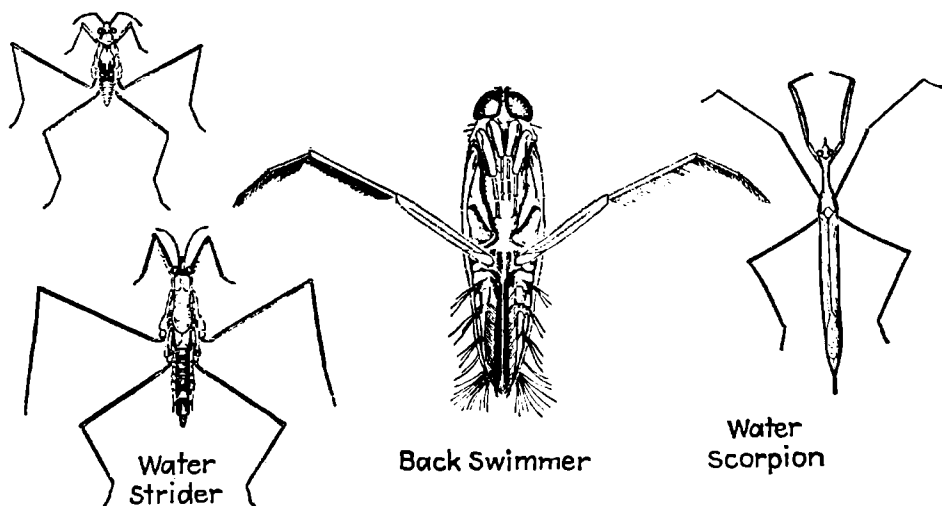
Length $\frac{1}{2}$ - $\frac{3}{4}$ in. Brown mottled with red, black, and yellow, with conspicuous white V on back between wing bases. Wings of adult almost reach to end of abdomen. Shorter and broader than meadow plant bug.

Found on over 50 different kinds of plants in Europe and America, including corn, apple, dahlia, aster, wheat, oats, and so on. Family has been called Capsidae, and all in it feed on plant juices; many cause plant deformities.

Eggs usually laid on flower of a composite plant, particularly horseweed, alternating feeding and egg laying for weeks. Eggs hatch in 7-10 days into nymphs that, during 5 molts, change from a pale yellow insect $\frac{1}{2}$ in. long, to green spotted with red, to brown, and finally, in 4-6 weeks, to adult. 2 annual generations.

Food plant juices, sucked, puncture ruining market value of apples, pears, quince, peach, plum, currant, strawberry, and grape and affecting cabbage, potato, turnips, beets, beans, many grains, and garden flowers. Winter is spent in adult stage, in leaves and trash.

Damage may be severe. Control is by flypaper barriers on trees, kerosene emulsion sprays, nicotine sulfate or soap sprays in early morning, covering crop plants with cheesecloth, and destroying weeds in borderlands.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Hemiptera

Family Gerridae

Water Strider, Jesus Bug
Gerris sp.

Body less than $\frac{1}{2}$ in. long; legs long, with fore pair suitable for grasping; second and third pairs suitable for driving, on water surface. Middle pair merely rests tips on water. Some species have short wings and some species have wingless individuals.

On surface of fresh or salt water, often crowded together in flocks. More common on quiet water but sometimes found far at sea. Some 20 American species representing 7 genera, with 9 species common in East. *Holabates* lives on ocean.

Mates from early spring through summer, male sometimes cutting off wings of female. Eggs laid on supports at water surface; hatch in about 2 weeks by a longitudinal split. Young jump about actively. Nymph like adult except for wings, with 5 stages each lasting about 1 week.

Food insects captured at or near surface, or sometimes by jumping into air. May feed on snails near water's edge. Some can swim under water, surviving submergence for several hours, while others drown quickly under water. Most are highly nervous in captivity. Protection effected by escape or flight.

Serve chiefly as scavengers of water's surface. Make poor aquarium pets because of nervous nature but may be fed dead flies or other insects dropped wounded on water surface. Winter is spent on or under sticks or stones. Of little economic importance.

Family Notonectidae

Back Swimmer
Notonecta sp.

Length usually about $\frac{1}{2}$ in. Body boat-shaped. Swims with back downward. Back lighter colored than under parts; usually black and cream-colored. Hind legs of *Notonecta* and *Buenoa* flattened and suitable for swimming. Eyes large. Furrow on underside enclosed by hairs, forming air chamber into which air is forced by hind legs.

Notonecta undulata general over United States, wherever water is suitable. *Notonecta*, with 12 species, may float at pond surface, while *Buenoa*, with 6 species, commonly swims slowly beneath surface. Related genus, *Plea*, contains one species, a small insect under $\frac{1}{8}$ in. long that feeds on crustacea.

Mates beneath water, in spring. Eggs white, $\frac{1}{12}$ in. long, glued to submerged stems, hatch in about 3 weeks; young resemble adults but of course have shorter wings. Some males, when adult, have structures that they rub to produce high-pitched sounds. This may be associated with reproduction.

Food chiefly small aquatic animals caught by pursuit and killed, or paralyzed by stinging. Some secrete a milky juice from thorax. Stings so severe that they may hurt man badly, so insects should be handled with care. In captivity, may be fed mosquito wrigglers. High mortality during molting.

Probably of little economic importance, but may serve as checks on multiplication of such aquatic pests as mosquitoes. May also kill young fish and serve as fish food. Always interesting as pets in aquariums. May have nematode enemies that kill off many if they are too crowded.

Family Nepidae

Water Scorpion
Ranatra sp.

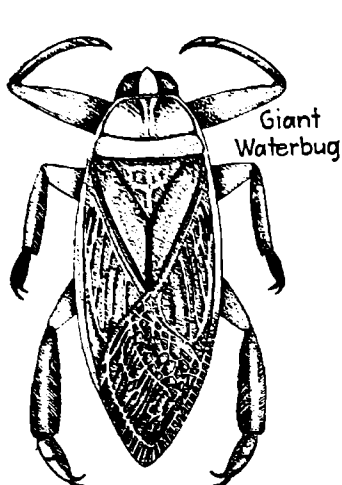
Length over-all, sometimes around 3 in. Slender and stick-like, with slender legs, the fore pair suitable for grasping prey. Other legs used in walking and in poor swimming. Filaments at rear of body form a breathing tube through which air may be drawn while insect feeds under water. Sucking mouth parts. Mostly plain brown in color.

Food either in deep water, in trash, or at surface, often bask in sun, entirely dry. *Ranatra* slender, common, and widely distributed. *Nepa* $\frac{3}{4}$ in. long, flat, and less common. *Curleta* intermediate in shape and size, and found in south central states.

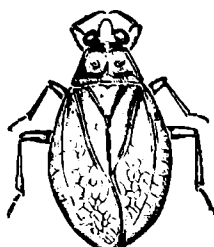
Mating a prolonged process. Eggs laid under water in decayed vegetation or on live plants, inserted in holes; hatch in 2-3 weeks; young resemble adults but go through 5 molts; about 40 days from egg to adult. Female a most prolific egg layer. Winters in adult stage. May chirp by jerking rigid limbs and a shoulder rasp.

Food other animals caught and held by forelegs while juices are sucked out. Prey caught by lying in wait. When first brought into strong light, avoids it, but soon reacts by going toward it. May hibernate during times of year when oxygen content of water is below normal.

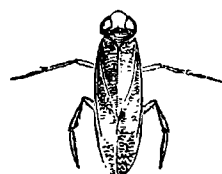
Not of economic importance but may serve to check multiplication of small forms of water life. May be reared in captivity by feeding on cockroach nymphs. Interesting to naturalists because of unique breathing, locomotion, food capture, and reproduction.



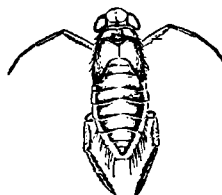
Giant Waterbug



Smaller Giant Waterbug



Water Boatman



PHYLUM ARTHROPODA. CLASS INSECTA
Order Hemiptera

Family Belostomidae

Family Corixidae

Giant Water Bug
Leibocerus americanus

Length 2, 3, or more in. Broad, flat, brown. With conspicuous strong grasping forelegs, short piercing beak, strong middle and hind legs suitable for swimming, prominent beady eyes, and wings that fold compactly to cover the abdomen above. Powerful insects and able fliers.

Genus *Leibocerus* includes large members of the family, with 5 species known in United States and Canada, relatively well-distributed. *Benacus* includes another large-sized similar insect. *Belostoma* and *Abedus* are usually smaller.

Egg laying and mating alternate with feeding during much of adult stage. Eggs laid in trash, hatch in 1-2 weeks; nymphs resemble parents except for wing development and go through 5 nymphal stages to reach maturity. Breeding period may last from May-August, during which time 150 eggs may be laid.

Food any animal found in its environment that can be captured. Prey held by strong forelegs while beak is used to pierce and suck out juices. Fish, frogs, other insects of many sorts serve as food. Adults are attracted by strong lights at certain time, hence name electric-light bugs.

May be real pests in fish hatcheries, where they destroy eggs, young, and even adult fish and consume food that these fish might need to live. Might themselves serve as food but not enough to compensate for loss. Known to kill fish 4 times their own size.

Smaller Giant Water Bug
Belostoma sp.

Length about 1 in. Much like electric-light bug except for size. Brown. Grasping forelegs less conspicuous than in giant water bug. Wings of adults folded on back. Basal segment of beak longer than second, while in giant water bug it is shorter.

Found in waterways and about lights but feeds mostly in waterways. Flies readily from pond to pond in adult stage. Some relatives in Brazil and Guiana are at least 4 in. long. Genus *Abedus* has a strong keel on underside of forepart of body, which is lacking in genus *Belostoma*.

Mates mostly in water. When mating is over, male finds himself with fertilized eggs glued to his back by female. He carries these about during 1-2-week incubation period. Young nymphs free themselves and leave father bearing the shells. Molts, 5. Nymphs resemble adults.

Like giant water bug, these insects feed on any animal they can overcome, but mostly on those to be found in water. They do not go out on land to seek prey. Feed readily in captivity, sometimes almost immediately after having been caught. Attracted by light.

May serve to some extent as food for fishes but may also do considerable damage to young fish; serve as direct competitors for food with many important kinds of fishes. Normally not of serious economic importance.

Water Boatman
Corixa sp.

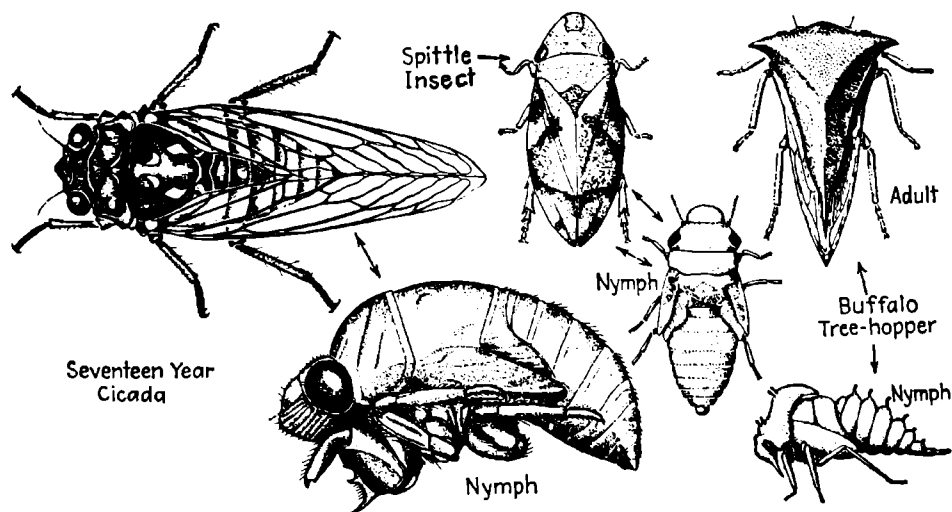
Length to nearly $\frac{3}{4}$ in. Body shaped like a blunt-ended boat, with hind pair of legs suited for swimming with an oar-like motion, and front pair of legs suited for scraping oozes that make up food. Males with last 4 segments under abdomen not symmetrical. Swim right side up, unlike back swimmers. Eyes often red.

Lakes and streams of fresh water, moving or stagnant; widely distributed through world. Some 55 species divided among 6 genera in one American checklist of family. Name "corix," from which family name was probably developed, means bug; given group possibly because they smell like bedbugs.

Males may chirp by rubbing front feet against beak and opposite leg. Eggs yellow, top-shaped, laid on submerged plant trash, or, in one species, on living crayfish. Young show eyespots in 4 days, with 5 molts; nymph more nearly like adult. Winters as adult, though young have been found in January.

Food exclusively plant oozes growing on submerged objects and scraped into mouth with rakers on front feet. Protection effected by great numbers, by escape, and by general inconspicuous nature. Young cannot thrive in boiled water. More active on dark days than on bright. Probably active at night throughout year.

Adults and eggs are collected in great numbers and used as food by man and birds in Egypt and Mexico. Imported into England for use as food, 1 ton approximating 250 million individuals. May be used also as fish food or as food for young game birds in wildlife management. Scavengers.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Homoptera

Homoptera are sucking insects whose wings, if present, are uniform throughout and when not used are held sloping over the body. Sucking beak attached to back part of underside of the head.

Family Cicadidae

Seventeen-year Locust *Magicicada septendecem*

Length about 1 in. Body stout, black. Eyes orange, prominent. Forelegs suitable for grasping. Wings at rest extend beyond end of abdomen. Most of abdomen a drum, with drumhead just behind base of wings, drums being vibrated by internal structures in males. Wings not sound-producing organs.

In United States, at least 74 species of cicadas in 16 genera; relatives found elsewhere in world. Adult lives usually in treetops, though most of life is spent underground. At least 20 distinct broods of this species in United States, so insect may be found any year. Dog-day harvest fly, *Tibicen*, of the East, is larger and has 2-year cycle.

Eggs laid by female in late summer by making slits in twigs. About 16 are laid in a group, to 500 per individual. Eggs hatch in 6-8 weeks. Nymphs fall to ground and remain 12-13 years with intermediate stages in fifteenth and sixteenth years. Nymph stage may be spent from near surface to 10 ft. underground.

Sucks juices from roots and stems and may make way through solidly packed earth by softening earth with water. Males alone make sound, though females may have drum-like abdomen. Adult stage lasts only a few weeks in summer. A 13-year form is common in South, while northern form has 17-year cycle.

May injure plants at all times, but most injury is caused by female when she lays eggs closely together on twigs, sometimes killing fruit trees in this way.

Family Cercopidae

Spittle Insect, Froghopper *Lepyrionia quadrangularis*

Length of adult under $\frac{1}{2}$ in. Brown, with 2 oblique darker bands on wing covers, black beneath. Vaguely frog-like in appearance. Best known from the frothy "spit" found on plants as a cover, usually for nymphal stages. Adult densely covered with minute hairs.

Common on grasses and other low plants in summer months. Adults may leap from plant to plant, or fly, as need be. Some 25 species in this family in United States; family closely related to the leaf hoppers, plant lice, and cicadas.

Eggs laid by female in plant tissue, hatch into nymphs that cover themselves with protective froth. Number of nymphs may live in same froth mass. Froth comes from liquid freed from alimentary canal as a mucous fluid and beaten into froth. Froth represents more plant juice drawn than can be used as food.

Food obviously plant juices. Function of the froth has been interpreted as associated with respiration, as providing protection against parasites, and as maintaining a constant climatic condition where nymph is developing.

Generally considered of little economic importance. Nicotine sulfate spray is used as control measure. Since so many people think of froth as "snake spit" or "frog spit," it is obvious that the insect is commonly observed. Also obvious that few people investigate a strange phenomenon, or froth maker would be discovered.

Family Membracidae

Buffalo Tree Hopper *Ceresa bubalus*

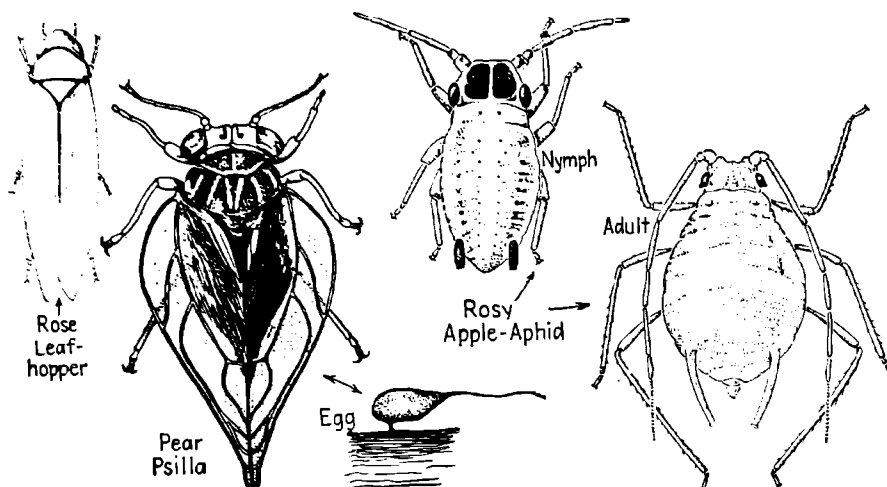
Length under $\frac{1}{2}$ in. Usually resembles a spine, bud, or natural plant swelling. Some species distinctly spine-shaped. This species reputed to be shaped like buffalo horns. Grotesque shapes are developed by abdomen. This species dirty yellow with brown spots.

Found on trees and other woody plants as adults, and commonly on herbaceous plants as nymphs. 185 species in United States, representing 43 genera. Other species include two-horned tree hopper, two-marked tree hopper, and others.

Eggs laid by female in slits in bark of 2-3-year-old woody plant stems, such as elms or apples, in September, 6-8 in a slit. Hatch in May into nymphs that in 30-35 days go through 5 stages of about 1 week each. Young stages are spent on weeds and adult stages on woody plants.

Food, juices of plants on which they occur, juices being sucked through beak. Females may be only ones to migrate to trees for egg laying, males remaining on weeds where young stages are spent.

Chief injury is due to egg laying that deforms and weakens trees, permitting them to be broken easily by wind or infected by other insects that use old scars for entrance. Control by keeping grass down in orchards, burning infected twigs in fall and winter. If there are no near-by weeds for young, there will be few adults on trees.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Homoptera

Family Cicadellidae

Rose Leaf Hopper

Empoa rosea

Length to $\frac{1}{8}$ in. White to pale green, long, slender, with wings of adult extending beyond tip of abdomen. Antennae about length of forelegs. Eyes rather conspicuous, occupying, when seen from above, about $\frac{2}{3}$ top of head.

Common everywhere in United States, British Columbia, Ontario, and Nova Scotia; originally from Europe. Common on members of rose family and in Northeast is serious pest of apples and rosebushes. More than 700 species of family in the United States.

Eggs $\frac{1}{40}$ in. long, laid in fall, on bark of rose, apple, or similar plants. Winter eggs hatch in 6-7 months; summer eggs, in 25 days into nymphs that in 33 days go to adulthood. Second brood of summer may be completed in 17 days after hatching, growing from $\frac{1}{25}$ in. to $\frac{1}{4}$ in. long.

Food plant juices sucked. Single rose-bush may support thousands of these leaf hoppers. Young of first generation feed on rose, but when wings are developed adults fly to apple trees to feed; second-generation adults return in fall to lay eggs again on rosebushes.

Control of this apple pest may be helped by keeping rosebushes away from orchards. Nicotine sulfate sprays are used. Western beet leaf hopper transmits curly-leaf disease, grape leaf hopper affects grapes, and six-spotted leaf hopper, grasses.

Family Chermidae

Pear Psylla

Psylla pyricola

Length about $\frac{1}{10}$ in. Reddish-crimson, with brownish-black markings, dark wing veins, and bronzed eyes. In general, appears like small cicada. Produces abundant honeydew that is sticky and trickles down trunk of host tree or drops to ground. This becomes black with a fungus and advertises presence.

Found commonly on pear trees, mostly on leaves, buds, or fruit. Common throughout eastern United States south to Virginia and west to Mississippi; reported also in California. Native of Europe; introduced into America about 1832.

Spends winter as adult, hiding in crevices. In spring, eggs are laid on buds and twigs of pear. Eggs hatch in 2-3 weeks. Nymphs begin sucking juices of young leaves and fruits, secreting large amounts of honeydew; adults in about 1 month. May be 5 generations a year in South.

Food plant juices sucked to detriment of tree. Second-generation psyllas come from eggs laid on leaves, rather than on buds of twigs. Nymphs broad, flat, yellowish at first but becoming reddish, with bright red eyes; rather different in appearance from adults.

Control by destruction of adults in winter, by ridding orchard of trash and loose bark, by spraying with whale-oil soap and kerosene emulsion. Lime-sulfur spray, 1 part of the wash to 9 parts of water, will kill eggs and young nymphs and is used as a check.

Family Aphididae

Rosy Apple Aphid

Anuraphis roseus

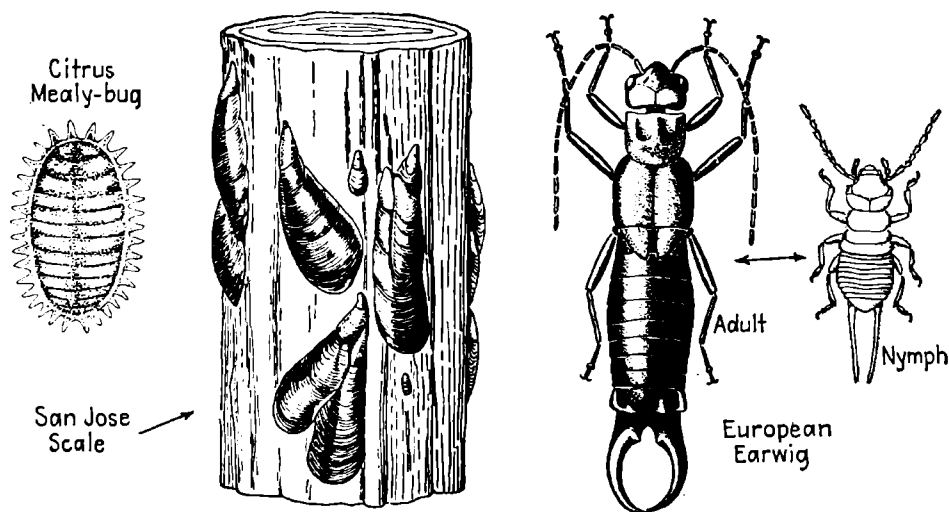
Aphids range in length from $\frac{1}{65}$ - $\frac{1}{6}$ in. Winged and wingless adults in many species. Wings are usually held like a roof over back and forewings are larger than hind wings. Sucking mouth parts. Honey tubes at rear of abdomen secrete honeydew eaten by ants.

Rosy apple aphid native of Europe but widely established in world, where it feeds mostly on thorn apple and mountain ash. Wingless females vary from pink to rose, orange, tan, or black. Variety of aphids great. Many live in galls, some on roots, on leaves, on stems, and so on.

Typical aphid life cycle: Winter eggs hatch and develop into usually wingless stem mothers, which give rise to wingless females; these produce a number of similar generations, without mating; then a winged generation moves to new host and produces young without mating; finally, another winged generation is produced, and this lays fertile winter eggs.

Food plant juices exclusively; each species relatively limited in host, usually to closely related plants. In some, like corn-root aphid, aphids are placed on host corn root by ants that feed on honeydew yielded by aphids. This ant-aphid relationship is fairly common, with variations.

Highly injurious to plants. Controlled by encouragement of natural enemies; by use of lime-sulfur wash to kill winter eggs; by spraying young in early stages with contact sprays such as 7% kerosene to 1 lb. whale-oil soap to 6 gal. of water; or by use of bordeaux mixture with whale oil and kerosene mixture added.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Homoptera
Family Coccidae

Order Dermaptera
Family Forficulidae

Coccidae include scale insects, mealy bugs, and others. Some tropical coccids yield shellac of commerce; some yield dyes; but most of ours injure plants. China wax in candles is made by these insects. Males usually winged; females wingless.

Citrus Mealy Bug *Pseudococcus citri*

Appears like a cottony waxy spot, about $\frac{1}{4}$ in. long. Female pale yellow and well-covered with powdery wax that is mostly light gray or white.

Common in warmer parts of America and, in the North, in greenhouses and on house plants. Important coccids in America include the cochineal insect (see page 268), tortoise scale, and many other scales.

Eggs numbering 300-500 are laid in loose cottony masses chiefly during fall and winter. Nymphs are indistinguishable as to sex in early stages, but adult females are wingless and adult males winged. Maturity is reached in summer following egg laying.

Adults and young move about freely, unlike scale insects. Food plant juices, sucked. Protection effected by cottony wax covering, which makes many sprays ineffective.

A number of natural enemies of this insect in the open. Spray is used with 8 lb. of soap boiled in 8 gal. of water, into which is mixed 1 lb. of crude carbolic acid. This is boiled about 20 minutes, then diluted with 20 parts of water. Hydrocyanic acid fumigation gives control in greenhouses.

Oyster-shell Scale *Lepidosaphes ulmi*

Appears like small crowded oyster-shell scales on bark of woody plants. Females under scales, about $\frac{1}{8}$ in. long; males under smaller scales. Males become winged but females remain wingless.

Too common. This species is found on dogwood, maple, and apple but is closely related to similar scales found on willow and ash. Distribution is world-wide.

Winter is spent in egg, 25-100 under a single scale. Nymphs emerge in late May, crawl around 3-4 hours, then form own scale, settle down for life, maturing in early August. May be 2 generations a year in northeastern United States, first eggs hatching about 2 weeks after apples bloom.

Female lays eggs under scale that has protected her for life. Food is sucked from plant host and, since scales may be closely crowded on small twigs, the host plant may be injured.

Adults active only during summer months. Lime-sulfur applied regularly in 10% kerosene emulsion when plants are dormant, and a soap spray applied in late May when insects may be free, are accepted control procedures. This is one of most serious orchard pests.

European Earwig *Forficula auricularia*

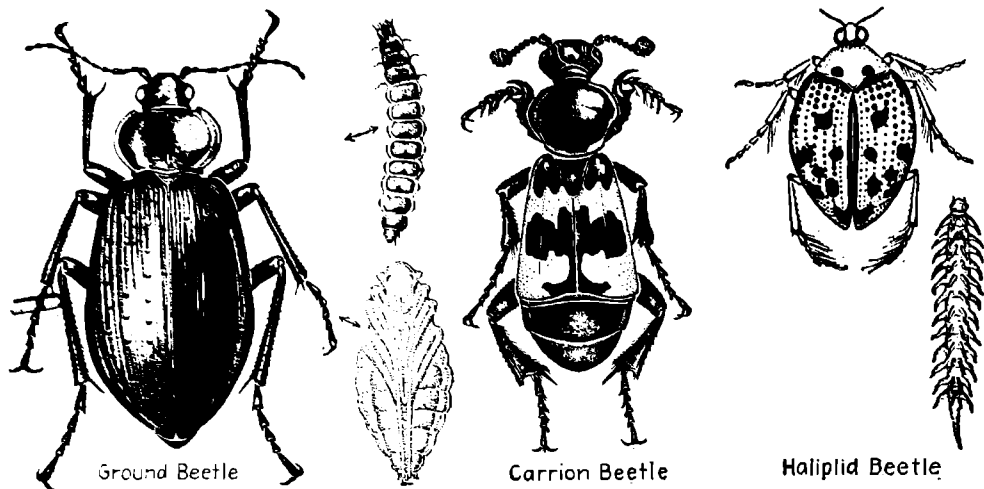
This order of insects comprises the earwigs. Adults have long narrow bodies, chewing mouth parts, and pincer-like structures at rear of abdomen. Wings may be absent or present. No pupal stage. Length to $1\frac{1}{2}$ in.

European earwig native of Europe but established in many parts of America. In West Coast area and in South, feeds on fruits, flowers, and vegetable material. Less common in East, where they are of minor importance. Appeared in Rhode Island in 1912.

Winters as adult or $\frac{1}{2}$ -in. eggs underground. By April females appear, guarding newly hatched nymphs for up to 4 weeks, or abandoning them. May lay second batch of eggs in June. Nymphs reach maturity in 2 or more months. In late summer adults congregate in great numbers, possibly as mating act. Males have bowed end appendages.

Food almost entirely plant material. Earwigs have habit of hiding in any available crevice during day and are then discovered in clothing, books, among dishes and elsewhere, much to displeasure of human beings. May destroy aphids.

Control where they destroy flowers, fruits, or stored foods by use of traps or poisoned baits. Commonly mixture is 16 lb. of stale bread to 1 lb. of Paris green or arsenic, ground fine, mixed with water, and spread over regions where insects have been seen. A nicotine sulfate spray is common where insects infest fruit trees.



Ground Beetle

Carrion Beetle

Halplid Beetle

PHYLUM ARTHROPODA. CLASS INSECTA Order Coleoptera

With 175,000 known species, the Coleoptera constitute largest group of insects. Adults have 4 wings, front pair thickened and horny. They have chewing mouth parts and a complete metamorphosis, with resting pupal stage.

Family Carabidae

Ground Beetle, Searcher *Calosoma frigidum*

Ground beetles are usually black or dark-colored. Some are brightly colored or with bright parts. They may be as much as 1 in. long and are active in larval and adult stages.

Found usually on ground, commonly under trash where moist. Some species climb trees, but this is unusual for group. At least 1,200 kinds of ground beetles in United States.

Some ground beetles lay their eggs in mud cells on leaves. Larva can run around actively and has strong jaws. In this species, it lies in wait for prey in a burrow. Larva may molt twice in about 2 weeks, before turning into inactive larva for another 2 weeks, then becoming a pupa for a week before becoming adult.

Food: most ground beetle larvae and adults feed upon other insects, particularly soft-bodied caterpillars that can be run down and eaten. They are most active at night. Adults may live nearly a year, wintering in that stage, with egg laying in some species limited to early summer.

Ground beetles are useful throughout their lives, since they prey on other insects that are for most part harmful to man's interests.

Family Silphidae

Carrion Beetle *Necrophorus marginatus*

Necrophorus marginatus is nearly 1 in. long, with cylindrical body. Dark with dull red markings on forewings, which frequently do not reach end of abdomen. Animal appears stout and rugged.

Found usually on dead animal matter, usually under cover. More than 100 species of carrion beetles in United States, including *Silpha americana*, a common short, flat, round insect.

A pair of *Necrophorus* finding a dead bird or piece of carrion will remove earth from beneath and place it on top, eventually burying the flesh. On buried flesh, female lays eggs, and the larvae that hatch feed upon it. Pupal stage is passed near by.

Food of larvae and adults, of course, is carrion they find and bury. Some carrion beetles may attack and kill small animals like snails, and some live on decaying vegetable matter. Some of larger species may move an animal size of rat some distance to get it buried properly.

These insects serve primarily as scavengers and, for most part, may be considered as beneficial. Those close relatives such as *Silpha bituberosa*, which feed on vegetable crops, may of course be considered pests. They are mostly western.

Family Haliplidae

Crawling Water Beetle *Haliphus fasciatus*

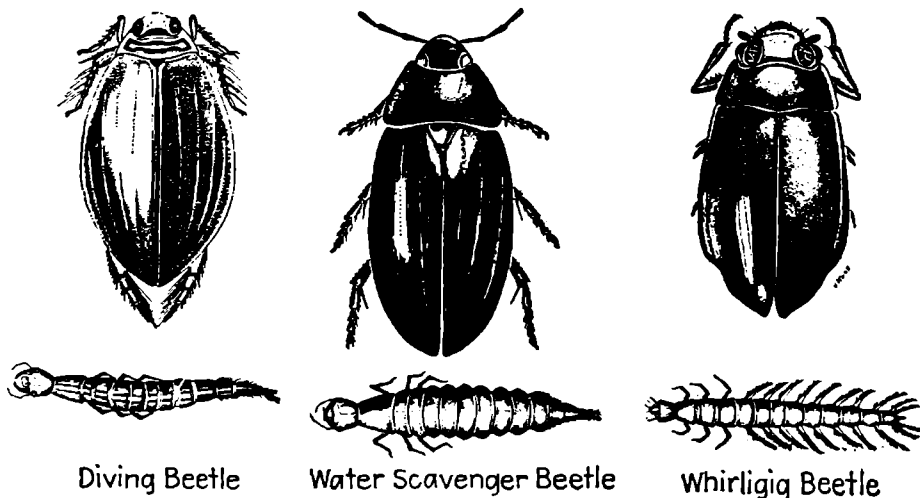
Length around $\frac{1}{4}$ in. Slow-moving, long-legged water beetle, with relatively distinct head, and underside of abdomen with conspicuously broad plates at base of hind legs. Straw-colored.

Found in fresh water, commonly among masses of pond scum, abundant in many springs and stagnant ponds. About 40 species in United States, divided among 3 genera: *Haliphus*, *Brychius*, and *Pelodytus*.

Adults mate in May or August. Females lay 30-40 eggs scattered among water plants. Slender larvae, with many lateral spines, may live through winter and in spring build a chamber about 1 in. under moist ground to rest 3 days before pupating. Pupal stage 12-14 days. This species places eggs in dead cells of *Nitella*. (See p. 42.)

Food of larvae and probably of adults, contents of cells of algae, interior being removed without necessarily breaking threads. A summer generation lives from May to August, and a second generation through winter. Adults air breathers; reserve air supply stored under plates supporting hind legs.

May serve some use as check on growth of pond scums and as food for fish and other water animals but, for most part, of little economic importance. They make satisfactory and interesting aquarium animals.



Diving Beetle

Water Scavenger Beetle

Whirligig Beetle

PHYLUM ARTHROPODA. CLASS INSECTA

Order Coleoptera

Family Dytiscidae

Diving Beetle *Dytiscus* sp.

Length of some species, $2\frac{1}{2}$ in. Usually oval, flattened beneath, black, or black and brown, with hind legs suitable for swimming. Females of some species, with forelegs furrowed. Males of some, with discs on forelegs. Carries air bubble at end of abdomen under water. Larva slender, with large jaws, active, voracious.

Common in ponds and streams, particularly in standing water, over muddy bottom. May be found on dry land, to which they may have fallen in migration. About 300 species in North America. Largest American family of water beetles.

After mating, around March and April, females lay 20-50 eggs, single, in slits in plants, under water. These hatch in about 3 weeks into larvae that develop 4-5 weeks before changing into pupae, which remain buried in earth from 10-20 days in summer, or longer in winter. Adults may be found at any time of year.

Food of larvae and adults, animal matter captured by pursuit or stealth and held in jaws and sucked into mouth. Young larvae may attack and kill own kind. In captivity may be fed raw beef or mixture of cereal, powdered shrimp, and ant pupae, grouped together. May feed on fish, young and old. Adults attracted by lights.

Enemies of other water animals that may be captured and overcome. Might easily be pests in fish hatcheries. Must destroy mosquitoes and other offensive water insects and must serve to some extent as food for useful fishes. Air is kept in reserve under hard forewings, entering abdomen through top.

Family Gyrinidae

Water Scavenger Beetle *Hydrophilus* sp.

Length of commonest eastern species, *Hydrophilus obtusatus*, $3\frac{1}{2}$ in. Usually black, elliptic, more or less flat beneath, convex above. In water, usually shows silvery film of air over undersurface. Larvae stouter than those of diving beetles, with more slender fore parts and more slender hollow jaws.

Found in fresh-water ponds and streams, though a few species live in moist soil or in dung. Found through North America and elsewhere, being represented in North America by nearly 200 species.

After mating, females lay about 130 yellow eggs enclosed in waterproof, cocoon-like structure, attached to plants near surface of floating as a raft. Larvae crawl about under water for at least 2 molts in 1 month's time. In late summer, pupal stage of about 12 days is spent in cell in soil. Adults may be found at any time of year.

Food of adults and larvae, small animals that may be captured alive, or decaying vegetation. Larvae feed on small animals, frequently sucking juices through hollow jaws. Adults may fly from pool to pool and are attracted by lights. May be helpless on ground. Have many parasitic enemies.

Food for some fishes. Larvae may be pests in aquariums or in fish hatcheries but may also be interesting to watch. They, like larvae of diving beetles, are known as "water tigers." Air, taken at surface by extending antennae and folding them back over bubble of air, is carried on lower surface.

Family Hydrophilidae

Whirligig Beetle *Dineutes* sp.

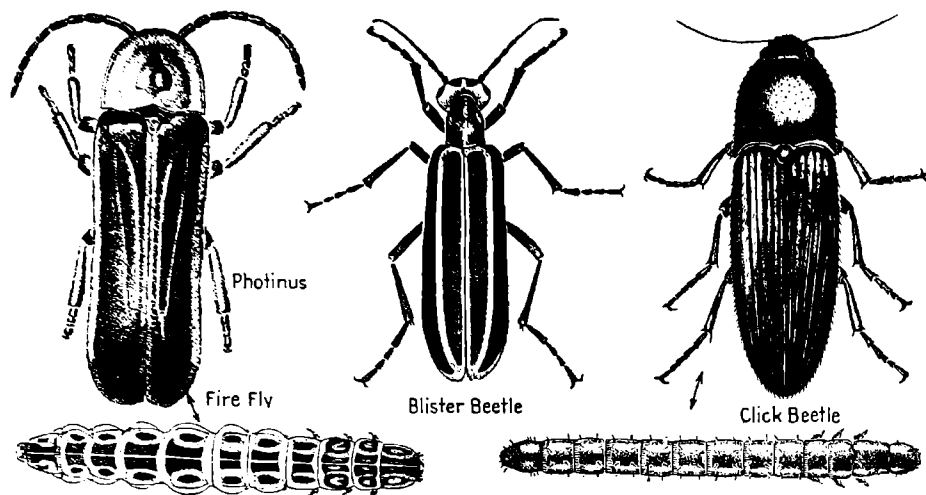
Length, *Dineutes*, usually about $\frac{1}{2}$ in.; *Gyrinus*, less than half that length. *Dineutes* flat, oval, blue-black or black and brown, with 4 eyes. Forelegs extended forward in a reaching position. Hind legs suitable for swimming and attached at center of underside. Larvae slender with conspicuous side appendages.

Found commonly on surface of quiet or running water, swimming in erratic paths, frequently in flocks of considerable size. In North America, 13 species of *Dineutes* and 26 of *Gyrinus*. Will dive to bottom when disturbed.

May fly from pond to pond. After mating, females lay 1 to many white cylindrical eggs, on submerged plants. These hatch into fierce-looking slender, flattened, light-colored larvae that finally leave water, and spin gray paper-like cocoons in which pupal stage of about 1 month is spent before transformation into adult.

Food of young and adults, probably solely animal matter, usually captured at surface alive. In captivity, may be fed raw beef on toothpicks left afloat. Protection by escape and strong odor that smells like apple seeds. Of 4 eyes, only 2 above the water function.

Interesting scavengers, with such common names as submarine chasers, lucky bugs, write-my-names indicating that they have attracted general attention. Do no harm and might figure to some extent in mosquito control.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Coleoptera

Family Lampyridae

Firefly

Photinus pyralis and *Pyroctomena borealis*
Length $\frac{1}{2}$ – $\frac{3}{4}$ in. Oblong, in general. With rather long nervous antennae. Comparatively short legs. Pale gray above; beneath, male is sulfur yellow from fourth and fifth segments of abdomen to end. In some species, females are wingless glowworms. Some species do not emit light at all.

Common over meadows and swamplands, particularly abundant near water. Larvae and wingless females are found in grass or sod. At least 50 kinds of fireflies in United States.

Adults use well-known light flash to attract each other, since they will come to captive insects behind glass but not to those in an opaque box. Eggs of some species luminous. Larvae of some species glow, live in soil or under bark, feeding mostly on soft-bodied animals, such as earthworms or snails. Luminous pupae in ground about 10 days.

Food of different species and stages varies from small soft-bodied animal materials to some plant material. Light is cold, produced in abdomen, probably by oxidation of granules in outer layer, oxygen being supplied by tracheae under control of nervous system. Some species flash in unison. Light usually yellow.

Of little economic importance for most part, but of tremendous challenge to understand production of cold light. Of course, they have inspired poetry and stories of all sorts. A Jamaican marsh lighted at 10-second intervals by hosts of fireflies simultaneously is a sight not to be forgotten.

Family Meloidae

Blister Beetle

Epicauta vittata

Blister beetles are about 1 in. long overall. This species striped above with yellow, red, and black; wing covers yellowish with 2 black stripes on each. Body soft, cylindrical, and joined to head by a distinct neck. Adults active. Larvae vary greatly in different stages.

Found mostly on foliage, flowers, and other plant parts, this species injurious to potato leaves. Over 200 kinds of blister beetles in United States, some useful, some injurious at different stages of life history.

Female lays eggs in summer or fall, in masses of over 100, commonly near egg capsule of grasshoppers. Eggs hatch in 12–22 days into active triungulin larvae, which may feed on grasshopper eggs several days, then molt into less active caraboid larva which feeds for a week, followed by 2 scarabaeidoid larvae of a week each, a fifth coarctate larva, a sixth scolytoid larva, and a 5–6-day pupa.

In immature stages, these beetles are distinctly useful as destroyers of other insects. As adults, their eating of plant tissues is harmful. Blister beetles can give off a stinging substance that may cause serious skin injury if too concentrated.

Economic importance varies. Some are serious pests in spite of their useful youth. Some are ground, dried, and made into a paste. Spanish fly produce cantharides used in medicine for making blisters. Adults are destroyed by stomach poison of 4 lb. of lead arsenate to 50 gal. of water.

Family Elateridae

Click Beetle, Wireworm

Melanotus communis

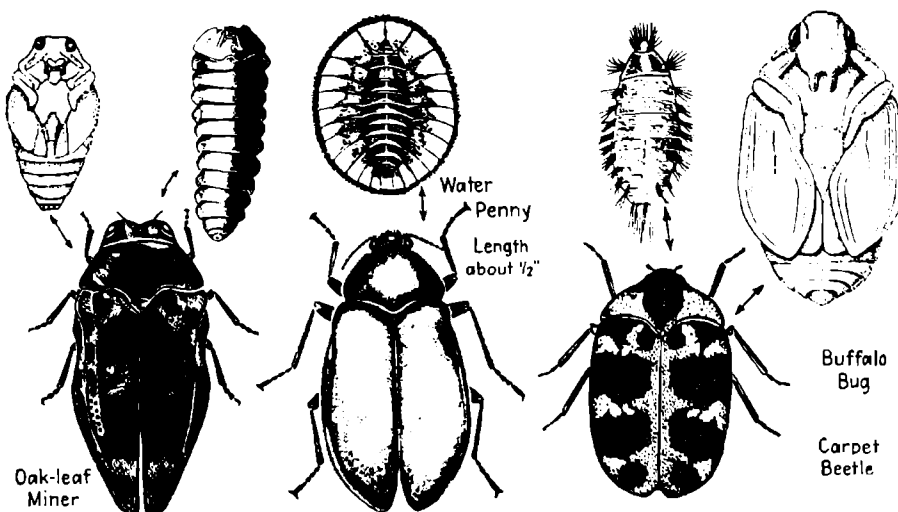
Length of common species varies from $\frac{3}{10}$ – $\frac{3}{4}$ in. Some are 2 in. long. Most are uniformly black, gray, or brown. Conspicuous because of flexible joint at base of wing covers that bends quickly, flipping beetle into the air. Some have conspicuous eyespots on back. Larvae slender and somewhat worm-like.

Found commonly about lights, in or near grass sods, or in decaying wood. Over 500 kinds of click beetles known from North America alone and many of them are of considerable economic importance.

Winters as adult or undeveloped larva. Adult emerges late spring; feeds for awhile, mates, lays many $\frac{1}{10}$ -in. white to yellow eggs in sod, which hatch into yellowish or brown round hard-shelled larvae; these may require to 4 years to reach maturity, and have pair of legs on each of 3 segments back of head. Pupates July or August, in earthen cell for about 1 month, 6 in. underground.

Food almost exclusively plant material. Some species feed on decaying plants, but many feed on cotton, potato, corn, wheat, sugar beets, grass, and other important economic plants; no generalization can be applied safely to all click beetles.

Control, where needed, is by crop rotation, avoiding planting corn or root crops in newly turned sod, but planting clover, peas, buckwheat or beans, which are less susceptible to injury. If sod land must be used, plow it in midsummer and cultivate thoroughly in fall before planting.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Coleoptera

Family Buprestidae

Oak-leaf Miner *Brachys ovatus*

Small oval beetles with short antennae; at first white, but later darker, with metallic iridescence due to change in color of hairs and scales. Mine is a large blotch on leaves of oak. Adult beetle widest at base of wings.

Common in leaves of red oak and less common in chestnut oak. Family includes many beetles that bore into wood or leaves of plants. In Needham, Frost, and Tothill's "Leaf-mining Insects," this species is described with *Pachyschelus* that mines *Desmodium* and *Taphrocerus* that mines bulrush.

Eggs laid singly on surface of leaf of host plant, in early summer or late spring; hatch and larvae bore into leaf. Larva legless, sheds skin 3 times, makes blotches that often cross main veins of leaf; remains in leaf through winter on ground. Pupal stage in May, about 1 week.

Food interior of leaf, leaving upper and lower surface as protection to larva. Since larvae remain in leaves through winter, no extra protection is necessary.

Of little economic importance since they are rarely abundant enough to interfere with prosperity of host trees.

Family Psephenidae

Water Penny *Psephenus* sp.

Length about $\frac{1}{4}$ in. With relatively long legs, oval flattened bodies clothed with fine hairs that retain a film of air when beetle is submerged. Larvae flat oval discs, looking more like crustaceans than insects. Legs not fitted for swimming.

On stones, near or in running water, but adults able to fly well when disturbed. Abdomen of Psephenidae has 5 segments, that of related Dryopidae has more. 1 eastern and 3 western species of *Psephenus* in North America.

After mating, females lay eggs about $\frac{1}{125}$ in. in diameter, in layers on underside of submerged stones, in June. These hatch into flat larvae that probably spend over a year developing before becoming pure white pupae, under stones or damp cover near water's edge.

Food of larvae and adults not well understood, but probably associated with running water; probably oxygen demands of larvae are high. Rapid water provides a degree of protection and perfect streamlining of larvae reduces hazards of swift water. Adults favor sun and heat and often congregate.

Of little economic importance, except possibly as fish food. Their presence in a stream indicates year-round flow and well-aerated water.

Family Dermastidae

Buffalo Bug, Carpet Beetle *Anthrenus scrophulariae*

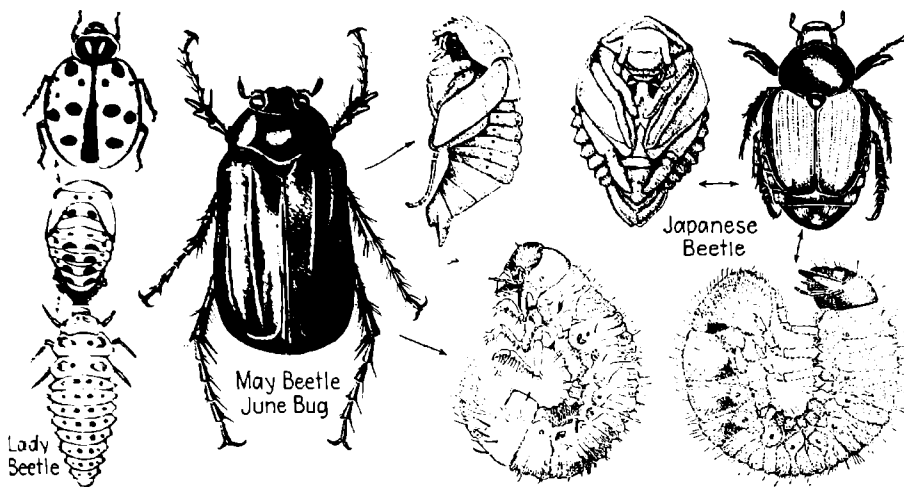
Length about $\frac{1}{4}$ in. Attractive, black, white, and red with a black background, spotted and speckled with white, and a central red line down back. Larvae nearly $\frac{1}{4}$ in. long, clothed with long brown hairs, those on sides and under rear parts longest.

Since first introduced into America about 1869, it has become a serious pest. Native of Old World where it was worst in museums but is now established in America from coast to coast, where it seems to be worse than in Europe.

Wrinkled, white eggs laid on clothing, feathers, furs, silks, carpets. These hatch in 2-3 weeks into grubs that reach $\frac{3}{8}$ in., during which time skin is shed 6 times and damage takes place. Pupae formed within last larval case and smaller than larvae. Adults appear winter to spring.

Food of adults, pollen of flowers, such as spiraea; but food of larvae is usually materials valuable to man. Adults found in spring and winter on ceilings and windows, attempting to escape to out of doors. Adults and larvae tend to congregate at different places.

Control is by keeping adults from laying eggs on valuable property, by using wool baits from which adults may be destroyed, by using sulfur fumigation and kerosene in cracks where larvae or adults may hide, and by destroying infected materials where this is possible.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Coleoptera

Family Coccinellidae

Convergent Lady Beetle
Hippodamia convergens

Length about $\frac{1}{4}$ in. With 2 white converging dashes on back, in front of wings, and 12 black dots on orange wing covers; thorax with white border. General appearance like small split pea. Lady beetles are usually red, black, or yellow, and spotted. Larvae active, usually dark-colored.

Adults common, and larvae very common on melon vines. Some adult beetles are found in houses on windows in spring and fall and some congregate in great numbers under trash on ground, for hibernation. About 100 species of lady beetles in North America. Mostly useful, but some pests.

Eggs laid in spring, on plants. Larvae begin eating small insects and insect eggs or even spiders, and grow rather rapidly. Finally transform into pupae that hang by tails a few days before transforming into adults.

Food of this species small animals only, including many kinds of plant lice and eggs of asparagus beetle, Colorado potato beetle, grape-root worm, bean thrips, alfalfa weevil, and chinch bug. Related Mexican bean beetle devours leaves and is a serious pest.

On Pacific Coast, convergent lady beetles are collected in great numbers and distributed in crop areas. 30,000 are considered adequate for protecting 10 acres. Takes about 1,500 to make 1 oz. and they are collected by the ton. Mexican bean beetle controlled by spray of 1 lb. of magnesium arsenate to 50 gal. of water, or by dusting.

May Beetle, June Bug
Phyllophaga sp.

Length to 1 in., or as short as $\frac{1}{2}$ in. Stout, usually brown and glossy above, with small heads and relatively slender legs; clumsy behavior. Larvae, "white grubs," usually with rear bent forward beneath, dark heads, and short stout legs forward.

Adults found in treetops or about houses where they are attracted by lights at night. During day remain hidden. Larvae underground. At least 100 species in genus. In South, common in longleaf pine area; less common on West Coast but worst in Mississippi-Great Lakes region.

Eggs 50-100, white, cylindrical, laid in glued-earth cell, underground; hatch in 10 days to few weeks into white grubs; these do not mature until second or third summer, spending winters deeper in soil. Pupal stage in earth cell 3-10 in. underground, maturing in August or September. Adults emerge following spring.

Food plant material, through 3 years of life cycle. Adults feed at night on tree foliage, returning to hide in soil at daybreak. Adults feeding may sometimes be heard. Grubs have important bacterial enemies and are eaten by skunks, bears, crows, and other animals.

May strip trees of leaves, grass sod of roots, and completely destroy such crops as potatoes, small grains, and buckwheat. Control: do not follow sod with row crops in year after beetles were abundant; deep fall plowing and pasturing of pigs and chickens in infested fields may help somewhat. Natural enemies may be fostered and parasitic fungi may be spread.

Japanese Beetle
Popillia japonica

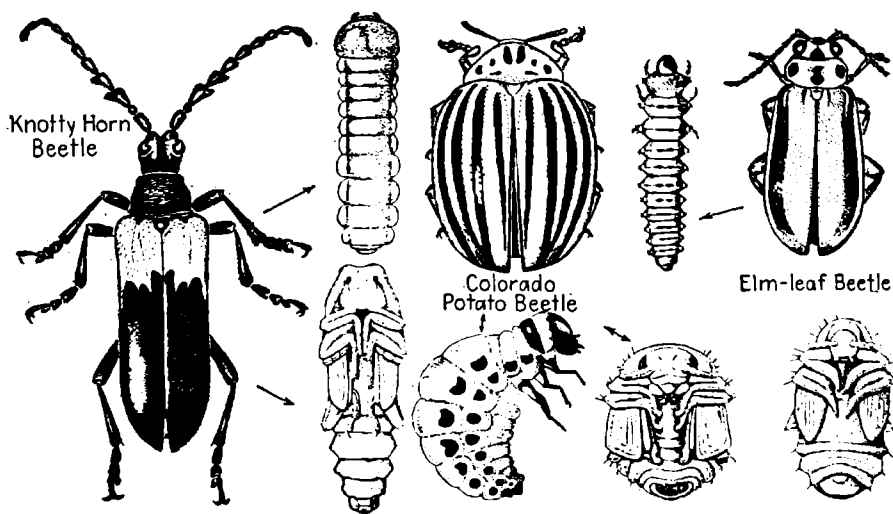
Length about $\frac{1}{2}$ in. Shining green body, with white spots on end of abdomen beyond end of wing covers. Popularly described as a green potato beetle and sometimes known as green Japanese beetle. Larva like a small white grub.

A native of Japan, discovered in New Jersey in 1916 and since spread over wide territory. In first 8 years in America, it appeared in an area of over 2,500 sq. mi. and still was not under control. Often so abundant that 1,500 grubs may be found in 1 sq. yd. of sod.

Tiny white eggs are laid usually in uncultivated soil, in July or thereabouts. White grubs that hatch from these feed through summer, spend winter deeper underground, enter pupal stage for a short time in spring, emerge as adults in June and July, mate and feed for 2 months or more, causing great damage.

Food of larvae and adults, many kinds of cultivated plants, especially grapes, raspberries, blackberries, strawberries, apples, cherries, corn, clover, soybean, roses, hollyhocks, elm, birch, linden, and many other valuable kinds of plants. When feeding in great numbers, may leave nothing green growing.

Control by burning trash, by DDT, or by strong spray, at least 3 lb. of arsenate of lead and 2 lb. of flour to 50 gal. of water, though peaches will not survive this spray. Some parasites have been introduced that may eventually provide adequate control; this probably is best pathway of attack.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Coleoptera

Family Cerambycidae

Cloaked Knotty-horn Beetle
Desmocerus palliatus

Most attractive blue and yellow beetle, with yellow in a broad band across middle. Antennae and legs about as long as body, which is under 1 in. long. Head much smaller than might be expected of a beetle of this size.

Found particularly on elder bushes, in summer, sometimes in considerable numbers. About 400 species of long-horned beetles in America, the more important associated with injury to woody plants; many are most attractive in appearance.

Adults mate in late spring or early summer on elder, where they lay their eggs. Eggs develop into larvae that bore into pith of elder and spend growing period there. This provides them with year-round protection where needed.

Food plant material; in this species, pith of the elder. Fortunately, this species limits its activities to relatively unimportant plants and rarely appears in sufficient numbers to be considered a serious pest.

Usual control is to cut and burn infected canes. Associated beetles include the ribbed pine borer, *Rhagium lineatum*; the maple borer, *Glycobius speciosus*; the locust borer, *Cyllene robiniae*; the painted hickory borer, *Cyllene caryae*; and the oak pruner, *Hypermallus villosus*.

Family Chrysomelidae

Colorado Potato Beetle
Leptinotarsa decemlineata

Length of adult under $\frac{1}{2}$ in.; about $\frac{3}{4}$ as wide as long, with high arched back. Clay yellow, with 10 conspicuous black lines on wing covers. Head with a black spot above. Larva dull brick-red, soft, fat, and with a row of dark spots down each side.

Found mostly on potato plants, but originally on buffalo bur, *Solanum rostratum*, native of Rocky Mountain area. Began to spread from that area in 1859, moving at first at about 50 miles a year and reaching Atlantic Coast about 1874. Adults may be found hibernating in ground.

As soon as potato plants appear above ground, fertile female potato beetles lay masses of yellow $\frac{1}{4}$ -in. eggs, usually on lower surface of leaves. These hatch in about 1 week into red larvae that grow for 2-3 weeks before pupating underground near the plants. After about 2 weeks, adults emerge and second generation starts.

Food of larvae and adults, plant tissue only, preferably potato and related plants. Tomato and eggplant may sometimes be attacked as vigorously as potato. Beetles destructive throughout growing season of plants.

Natural enemies include crows, skunks, rose-breasted grosbeaks, toads, and numerous insect enemies. Artificial control is by dusting with Paris green, usually mixed with 10-20 parts of some inert material or used as a spray; or lead arsenate may be used as a spray.

Elm Leaf Beetle
Galerucella luteola

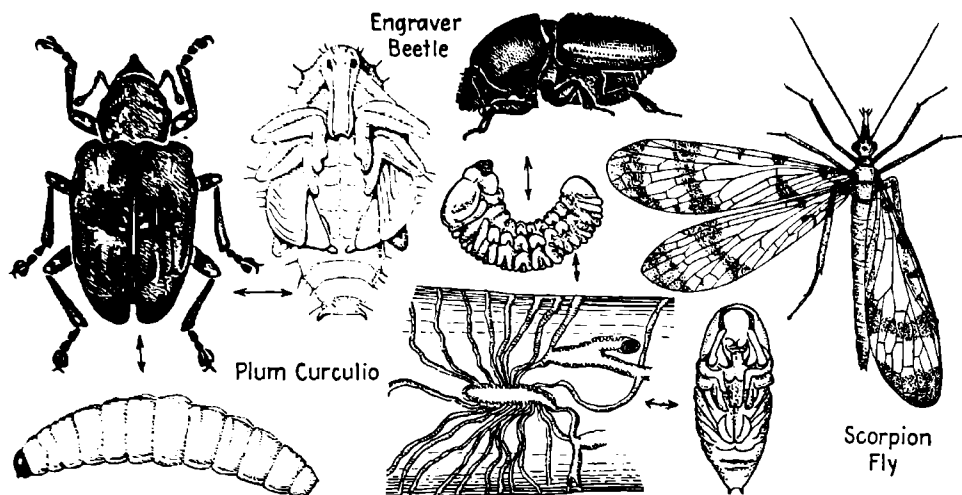
Length about $\frac{1}{4}$ in. Dull yellow with black spots on head and black band near outer edge of each wing cover; also with extra short dark streaks near front of wing covers. Sometimes grayish. Larva small, yellow and black, relatively active grub.

Adults commonly hide in cracks in buildings or under bark of trees. May crowd on inside of windows and screens in spring. Introduced in America near Baltimore from Europe about 1834, and now rather widely established, particularly on English elm.

Eggs yellow-orange, laid on end in clusters of 5-30, on elm leaves. Yellow-black larvae hatch in about 1 week and mature in 15-20 days, spending this time on elm leaves. Pupation in ground or in bark crevices for 10-day period. Adults may mate and produce a second generation in a season.

Food leaves of plants like elms. Late in spring adults of first generation feed on and injure buds, injury appearing as series of holes in leaves. Larvae may leave only leaf skeleton, eating out all soft parts. Winter as adults. May begin hibernation yellow and come out dark green.

Cause great damage to valuable shade trees. Control is essentially by using power sprays, applying lead arsenate just after buds open and again 2 weeks later for most satisfactory results. Poison sprays necessary since food is chewed.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Coleoptera

Family Curculionidae

Plum Curculio *Conotrachelus nenuphar*

Length about $\frac{1}{2}$ in. In general, dark-colored but on close examination seen to be mottled with brown and gray. Wing covers rough, each with shining, black hump just back of middle. Unique snout in all snout beetles. Larva worm-like and well-known as the "worm" in such fruits as cherries.

A pest, particularly on fruit trees, practically everywhere in North America east of Rocky Mountains. Adults particularly active when young fruit is "setting" or earlier. The family includes some 1,800 species in America north of Mexico, divided into 13 subfamilies.

After hibernation on or in ground, adults emerge before fruits bloom, mate, female lays 100-300 eggs on young fruit; hatch in 3-5 days and larvae mature in 12-26 days, leave fruit, burrow in soil, pupate 3-4 weeks, emerge and feed on fruit about 2 months after flowering, making daily puncture for about 6 weeks.

Female makes incision in fruit and eats hole to depth of snout, ruining the fruit. In early spring, adults feed on buds and young leaves of apples, cherries, peaches, plums, nectarines, apricots, pears and such trees. Young fruits attacked may drop off or develop deformities that ruin marketability.

Damage in United States of this one species has been estimated at 8 million dollars annually. Control measures include destruction of rubbish that harbors wintering adults, pruning of trees to let in light that insects do not favor, grazing hogs and poultry in orchard to destroy pupae, and spraying with lead arsenate.

Family Scolytidae

Engraver Beetle *Scolytus rugulosus*

Length to $\frac{3}{16}$ in. Dark-brown with dull red wing-cover tips and red on legs. Presence easily recognized by burrows or burrow entrances that look like shot holes in bark of trees, entrances about size of pinhead.

Common on plum, cherry, apple, peach, and pear; closely related species attack other trees. This species found from Alabama to Massachusetts, on into Canada and west to Michigan. Burrows look like long-bodied spider with legs that are biggest at tips.

Male digs burrow in which female lays 40-70 eggs. Eggs hatch in 3-4 days into white grubs with yellowish heads; each burrows outward, branching from mother's burrow. Larval stage 30-36 days from time of leaving brood chamber. Pupal stage 7-10 days. Transformed adults may burrow further before emerging.

In closely related slash pine beetle, male cares for several females in reception chamber which he digs and guards. Unusual for any male insect to contribute a burrow for his mate or mates. Adults appear in April; second generation may winter as larvae.

Control by whitewashing trees in late March and in July and October. Slash should be destroyed or burned if infestation of these beetles proves dangerous to valuable standing trees. Infestation frequently follows forest fires and kills injured and weakened trees. Some trees drown larvae with sap as a natural check. Dutch elm disease associated with engraver beetle's work.

Order Mecoptera

Family Panorpidae

Scorpion Fly *Panorpa* sp.

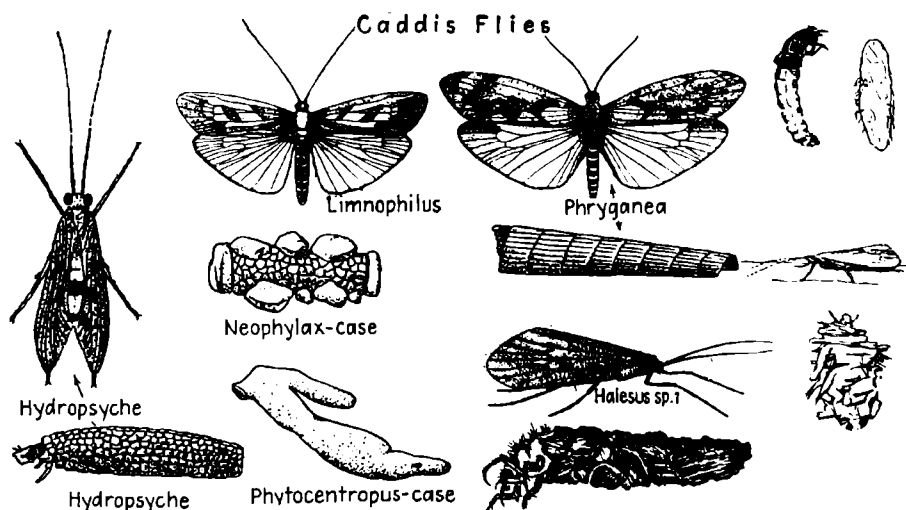
Scorpion flies, when adult, usually have 4 similar many-veined membranous wings, which are long, narrow, and roofed over abdomen at rest, commonly with dark spots. Head prolonged into beak. Tip of abdomen of some males bends up like that of scorpion.

Members of order occur in all parts of world but most are found in low damp wooded areas. Rarely abundant anywhere. Some species are on snow during winter. These may be wingless. Most species fly well. Some members of order are found as fossils.

Usually eggs are laid in masses in ground; larvae that hatch from them live in burrows underground and feed on surface. Larvae have 3 pairs of true legs and 8 pairs of abdominal legs and abdominal spines. Pupal stages apparently spent in earthen cells underground.

Food of larvae, probably other insects; of adults, dead or living insects and in some cases fruits. Larvae in confinement may be fed meat. They probably eat any available animal matter.

No great economic importance to these insects, but because of their carnivorous habits, they probably are more useful than harmful. Their numbers are so small that they cannot ever become serious pests.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Trichoptera. CADDIS FLIES

Caddis flies are soft-bodied insects with 4 membranous wings, each well-supplied with many longitudinal and a few cross veins. Wings usually held sloping like a roof over back, and more or less well covered with fine, easily shed, hair-like structures. Hind wings usually broader than forewings, and when not in use folded lengthwise. Forewings less membranous than hind wings. Insects vary in length from about $\frac{1}{8}$ in. to just over 1 in., and as adults, nervously move their long antennae that are held forward. Legs long and slender. Mouth parts suitable for chewing, though it is doubtful if adults eat any food at all in some species. Larvae discussed below. There is a pupal stage, so metamorphosis is complete.

Since adults are poor fliers and larval stages are aquatic, these insects are found in or near water. Larvae may be found in great variety of aquatic situations, from stagnant pools to dashing streams. Some 400 species of caddis flies in North America, divided among 13 families. Of these, Rhyacophilidae, Hydropsychidae, and Philopotanidae make their larval cases only in swift water, as represented below by Hydropsychidae. Phryganeidae, Leptoceridae, and Limnophilidae have larvae that live in quiet water or in a variety of types as indicated below.

Family Hydropsychidae

Water-net Caddis Fly
Hydropsyche sp.

Brownish oblong eggs are laid under water, on underside of sticks or stones, in patches, under a thin gelatinous coat. Larvae become greenish with darker fore parts, and build a funnel net, open upstream and ending in a pebble-bound silk cemented den. Pupal stage is spent in last larval skin. Pupa breathes by gills and swims to surface to transform into adult.

Food aquatic life caught in net, which has finer meshes at smaller end of funnel. As in other swift-water caddis flies, shelter of stones makes it possible for insect to resist push of water and let food come to it. Nets may become filled with sediment but can be renewed when necessary.

Family Limnophilidae

Log-cabin Caddis Fly
Limnophilus combinatus

Eggs laid under water by female in summer; hatch into larvae that use plant materials to build log-cabin-like cases which may easily be moved about in quiet water while food is being sought. Larval stage may last 11 months or from June to following May, then a different case, sometimes of shell, is built for pupal stage of about 3 weeks. Adult stage short.

Food of these caddis worms is caught by larvae floating about or moving their buoyant cases from place to place. If cases are removed, larvae will build new ones; if transparent film or cellophane materials are available in fine strips, insects show ability to select certain colors and reject others.

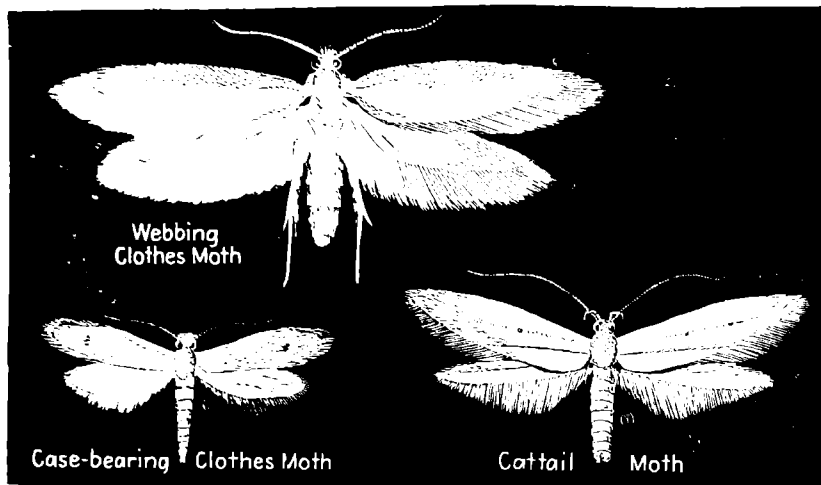
Family Phryganeidae

Caddis Fly
Phryganea vestita

Larvae of this species live in a plant-tissue tube made of narrow strips of leaf wound around a central core in a spiral. Others of family make case of strips placed around central core in narrow bands. Cases are abandoned when pupation takes place in submerged wood in a burrow closed by silk.

Food is obtained by moving about in relatively quiet water; moves easily because of buoyant nature of case. Some related families make burrows in plants through which they force a stream of water in which they construct a net to extract food organisms.

Caddis worms and caddis flies have considerable importance. Adults congregate in enormous numbers near lights; when they die, fine hairs from their wings are freed and in some cases may cause a kind of hay fever. Larvae of great importance as food for fishes and, since they are found in great abundance wherever fishes feed among plants or on bottom, they provide an ever-ready valuable food supply. Members of genus *Hydropsyche* were so abundant in Niagara River and were attracted in such great numbers to electric lights that site of Pan American Exposition in 1901 had to be moved inland from point originally selected. Aside from hay-fever aspect of their presence, they are entirely harmless, though annoying.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Adults of members of this order usually have 4 membranous wings, almost wholly covered with minute overlapping scales that rub off easily. Larvae have chewing mouth parts, though adult may suck nectar through a long proboscis. In most cases, food is plant material. Few are aquatic at any stage. Metamorphosis complete. About 9,000 species of moths and butterflies known in North America north of Mexico, representing 2 suborders and 70 families. Moths commonly fly at night, usually close their wings around their bodies or hold them horizontally when at rest, and have thread-like or feather-like antennae. Butterflies usually fold their wings vertically when at rest and have knob-tipped antennae.

Family Tineidae

Case-bearing Clothes Moth
Tinea pellionella

Wingspread about $\frac{1}{2}$ in. Grayish-yellow with faint spots on hind wings, and on hind wings a bit more silvery than forewings. A fringe of long hairs along rear margin of hind wings.

These moths fly at night, mostly during spring and summer months, but are not attracted by light.

Eggs are tucked away in folds of garments, or wool, feather, or silk objects. They hatch in about 1 week into worm-like larvae that live in tubular cases of foreign material. Larvae complete growth but remain winter torpid and inactive, and do not pupate for about 3 weeks before adults emerge.

Food of larvae, almost any organic material, particularly if it comes from epidermis of some animal, and this may include other insects. Food is chewed and a webbing trail is often left behind.

Highly destructive to stored clothing and furs and tapestries. Possibly more destructive in South, where there may be 2 generations a year. Control is by freezing, dusting larvae and pupae, exposing to air, DDT, or fumigation, and by preventing contact and storage of prey.

Webbing Clothes Moth
Tineola bisselliella

Wingspread just over $\frac{1}{2}$ in. Forewings more yellowish than in preceding, without spots or markings. Hind wings paler. Head reddish. Considerable variation in size.

Possibly commonest of the clothes moths, particularly in North, on a great variety of substances.

Eggs white, oval, tucked away among clothes, hatch in about 6 days into worm-like larvae, which make no case but leave a web in trail and may develop for nearly 1 year or less, with possibly 2 generations, one from May eggs and one from September eggs. Pupal stage about 2 weeks, in a rough cocoon.

Food of larvae, almost any organic material. Known definitely to eat other insects, but usually food must be relatively dry and undisturbed for a long time. Shaking may injure animals at some stages.

Control necessary. Beat articles to be stored in summer, expose thoroughly to sun and air, and then seal in paper bags or in tight trunks. Better yet, fumigate articles thoroughly in carbon disulfide for 2 days, then add abundant moth balls (naphthalene), a repellent, or DDT.

Family Cosmopterygidae

Cattail Moth
Lymantria phragmitella

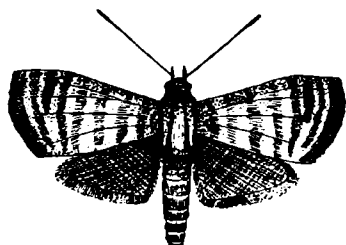
Wingspread $\frac{1}{4}$ in. Wings held like sides of a roof; slender, pale, silky, straw-colored, or light wood-brown, with 2 dots surrounded with white on forewings. Hind wings pale gray. Female stouter.

Common where there are cattails. World-wide distribution including Africa, Australia, Europe, Asia, and America.

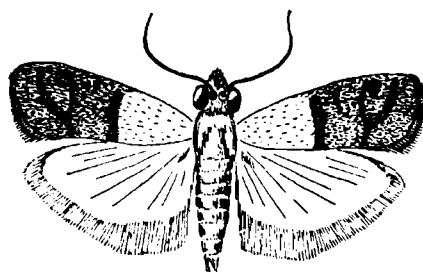
Oval, flattened eggs are laid on cattail spikes; develop into $\frac{1}{2}$ in. larvae, yellow-white with red-brown markings, which spin silk in cattail heads and prevent seeds from blowing away; winter as caterpillars in the heads. Pupate about 30 days, in $\frac{3}{4}$ -in. thin tough white cocoon in stem or head of cattail. Adults emerge in May. One generation a year.

Food of adults, nothing except water; of larva, tissue of cattail stems and fruits. Protection from severe weather provided in cattail head is unique and in some ways worthy of imitation. Protection from animal enemies is effected by surrounding plant tissues.

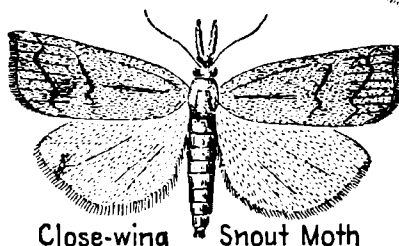
Not economically important since it does little damage to plant not ordinarily considered of much economic importance. Has some parasites. This animal causes the well-known "bursting" spikes of cattail that continue to hang together even through winter.



Codling Moth



Indian Meal Moth



Close-wing Snout Moth

PHYLUM ARTHROPODA. CLASS INSECTA

Order Lepidoptera

Family Tortricidae

Family Pyralidae

Codling Moth

Carpocapsa pomonella

Wingspread about $\frac{3}{4}$ in. Forewings like watered silk in appearance because of alternating irregular cross lines of brown and blue-gray; a large light-brown area bounded by chocolate and crossed by 2 metallic golden bands at hind angle of forewing. Hind wings coppery, darker toward margin.

Found mostly in or near orchards. A native of Europe introduced into America before 1750 and spread to Iowa by 1860, to Utah by 1870, and to California by 1874; now found wherever apples grow. Over 400 species in family, many serious pests.

Winter spent in larval stage, in silky cocoon under loose bark or other shelter. Cocoon tough, dirty gray. In spring, pupa formed in old cocoon or in a new one. Pupates for about 4 weeks as $\frac{1}{2}$ -in. yellow-brown object, with rows of minute black spines. Adult lays over 100 white eggs in about 10 days. These hatch in 6-10 days. Larvae feed on foliage and fruit about 1 month. 1-2 generations a year, more in South.

Food of larvae, some leaves at first but mostly fruit of apple, which it ruins for market purposes. Natural enemies include many insect parasites, birds, and some insects that kill larvae, eggs, pupae, or adults outright.

May cause 90% loss of apple crop, with United States annual loss well over 10 million dollars. Control by spraying young leaves and fruit with 4-6 lb. of lead arsenate or 1 lb. of actual DDT per 100 gal. of spray. Always consult county agent or Experiment Station for latest information on control.

Closewing Moth

Crambus luteolellus

Wingspread about $\frac{3}{8}$ in. Wings rolled around body when at rest. Male with long snout-like process and with claspers at tip of abdomen; dark-brown, cream, reddish, or dark gray with zigzag brown line near outer edge and no gold fringe. Female stouter, without claspers.

One of commonest small moths in grasslands east of Rocky Mountains, often seen perched lengthwise on grass stems. Since they are about thickness and color of straw, they are easily overlooked. About 70 species in genus, which also contains destructive cranberry girdler.

Eggs oval, yellowish to white, laid attached to grass or stubble; hatch in 6-19 days into white caterpillars with brown dots and brown heads, which are found in silky webs among grass roots. Winter as partly grown larvae. Pupae found among grass roots in weak cocoons for short period.

Food of adults, nothing; of caterpillars, plant tissue, particularly grasses and frequently growing corn. Food chewed; plant is injured if not completely destroyed.

Control is by fall plowing to destroy buried larvae; by rich fertilization, particularly with potash; and, in some cases, by burning over of stubble where infestation is serious and where damage by fire can be controlled or allowed.

Indian-meal Moth

Plodia interpunctella

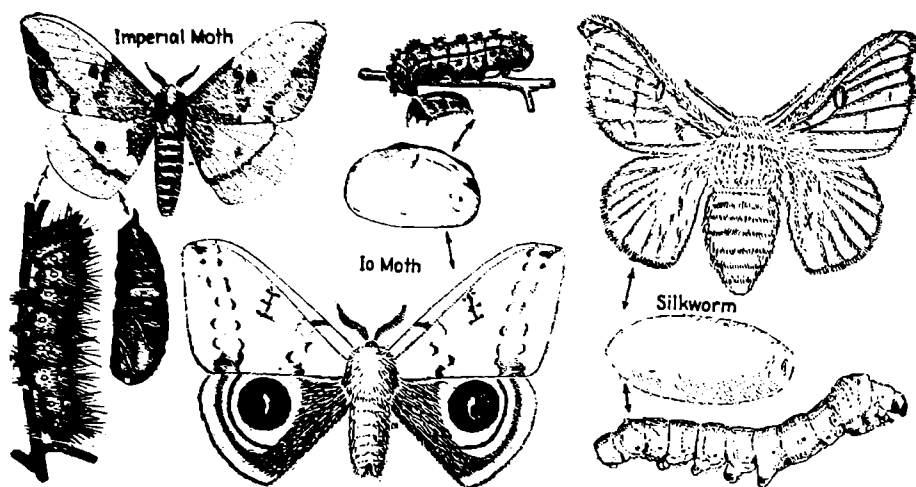
Wingspread to $\frac{3}{4}$ in. Wings at rest folded along back, basal third of forewings olive or buff, outer portion reddish-brown with a coppery luster. Under wings lighter and plainer. No conspicuous difference in sexes as to size or coloration.

Found about feedbins and granaries, particularly in summer. Also found in food stores or pantries in raisins, meal, and such products. Introduced from Holland about 1856 and rather generally established. About 300 species in subfamily; one useful as a destroyer of scale insects while another, in Australia, controls cacti.

Eggs, about 350 laid by a female, singly or in groups; hatch in about 4 days in warm weather, into crawling cylindrical sparsely haired caterpillars, hairs being about as long as body diameter. Head small. Larval stage 2 weeks or more. Pupae, $\frac{5}{16}$ in., brown, in food-covered cocoons, 7-10 days. Life cycle 4-5 weeks.

Food largely stored foods including grain meals, prunes, currants, dried apples, beans, walnuts, pecans, dried peaches, plums, clover and other seeds, crackers, dried bread, flour, and the like. Caterpillars can go forward or backward, leaving silk trail behind. Up to 4 generations a year.

Control necessary. Freezing temperature below zero continuously for 4-5 days kills insects or severe cold followed by high temperatures is effective. Sacks of food may be sprayed with carbon disulfide or fumigated. Consult county agent or Experiment Station.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Lepidoptera

Family Citheroniidae

Imperial Moth *Eacles imperialis*

Wingspread 5-6 in. Sulfur-yellow with bands and speckles of purplish-brown, with a large patch at base, a small round spot near middle, and a wavy band of purple toward outer margin. Male with outer margin of forewings purple-brown. Females with this margin yellow.

Adults in June or early summer, usually near forests on whose trees larvae occur. About 20 species of royal moths in United States, of which largest is the regal moth, *Citheronia regalis*, with 6-in. wingspread and 5-in. caterpillar.

Eggs laid in early summer on leaves of food plants. Larva develops into fierce-looking 4-in. caterpillar, with fine hair and tiny horns, green or brown for most part, with legs and head pale yellow, breathing pores white. Each segment has 6 yellow knobs with black spines. No cocoon is made, pupation being in ground.

Food of larvae, leaves of sycamore, hickory, pine, oak, butternut, and similar forest trees. Caterpillar not so fierce-looking as that of regal moth, which is known as "hickory horned devil." Pupa with long forked rear spine, used in working way up through soil before emergence.

Of no serious economic importance. Never common enough to be considered a pest, or uncommon enough to be valuable for sale to collectors. Related royal moth, reported in "The Girl of the Limberlost" as being extremely valuable, is worth only a few cents.

Family Saturniidae

Io Moth *Automeris io*

Wingspread to 3 in. Adult holds wings like slopes of a roof, or thrown back. Hind wings yellow and brilliant red, with a great eye spot in center of each. Male with yellow forewings, antennae broadly feathered. Female with forewings dull purple to brown, antennae not feathered.

Common in North America east of Rocky Mountains and in northern Mexico. Seen as adults most commonly at night. Family includes 43 North American species.

Eggs white with a black spot, nearly elliptical, laid in cluster of 20-30 on leaves, hatch in about 10 days into red-brown caterpillars which become yellowish then bright green with red-and-white stripes on sides; social when young, drawing together in masses when disturbed, or walking in processions. Pupae in thin irregular brown cocoons, on ground, over winter.

Food of larvae, leaves of corn, cherry, elm, apple, oak, willow, and other plants. Caterpillars have clusters of prickly spines that secrete a most unpleasant stinging poison.

Not usually abundant enough to be of any economic importance. Caterpillars are sometimes sufficiently numerous to annoy berry pickers who touch them.

Family Bombycidae

Silkworm *Bombyx mori*

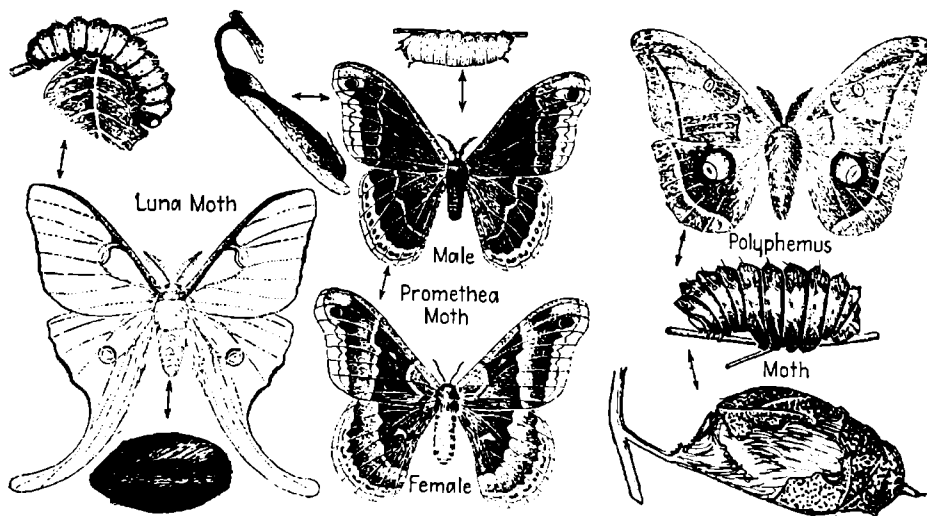
Wingspread about 1½ in. Antennae in each sex broadly feathered. Male cream-colored, with 2-3 more or less distinct brownish lines across forewings, and half an eyespot on inner half of hind wings. Head small and obscured by whitish hairs. Male rarely flies; female never flies.

Silkworm found only in domestication. Said by Chinese to have been domesticated by them since 3000 B.C. Later raised in India, then in Persia, and introduced into Europe about 555 A.D. As basis of big industry, it thrived in Greece, Italy, France, Spain, and Japan, in about that order, but never in North America.

Females lay 300-400 eggs that resemble turnip seeds; hatch in 8-10 days into caterpillars, which in 6-8 weeks grow from ½ to 3 in. long, shedding skin 4 times. Caterpillars usually white-humped behind small head, with short rear spine. 1-in. cocoon has about 1,000 ft. of silk, which is cut when moth emerges after 2 weeks in pupation. Egg to egg 2 months or more.

Food of larvae, leaves of mulberry, osage orange, or lettuce. Silk from silk glands hardens on contact with air. Pupae killed by steam; soaking in hot water softens gum that binds threads, permitting unrolling of silk and its spinning into thread. About 1,000 miles of silk per lb.

Silk supports great industries throughout world, but these depend on availability of cheap labor. Silk is being rapidly replaced by synthetic materials produced by chemists, and far-reaching social problems may be presented in providing labor for those who formerly made silk.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Saturniidae

Luna Moth
Tropaea luna

Wingspread to 5 in. Forewings thrown back in repose. Males beautiful pale green moths, with a small transparent eyespot on each wing; hind wings with extraordinarily developed tails; antennae, broad. Females with narrower antennae and much heavier bodies than their mates. Nocturnal. Found in May-June, again in August.

Common but never abundant in ordinary sense. Limited to area where its food plants, mostly trees, may be found.

Female may lay as many as 200 pure white eggs, fastened with reddish cement to twigs and upper leaf surfaces. These hatch in about 3 weeks; caterpillars are clear green with faint continuous lines over back from sides. Larva molts at end of 4, 7, 9, and 10 days, and 18 days later spins a thin leaf-covered cocoon for wintering pupa. May be 2 generations a year.

Food mostly leaves of birch, willow, hickory, walnut, oak, and other broad-leaved trees. When young, caterpillars remain together in groups. Plain green color provides excellent protection from enemies but they have many parasites.

Of little economic importance but always popular with amateur collectors, largely because of their great beauty. During day, moths usually hang beneath leaves with wings folded, rarely observed by passers-by.

Promethea Moth
Callosamia promethea

Wingspread about 4 in., wings held erect over back. Male diurnal, nearly black, with clay-colored borders and a blue eyespot near tip of forewing; antennae nearly twice as wide as in female. Female nocturnal, light brown, with basal half of each wing darker, with distinct eyespot near tip of forewing and light mark on basal half of each wing.

Common and widely distributed in eastern United States wherever its food plants are found.

Eggs small, white, depressed, and oval, fastened with red cement to underleaf surfaces, few in a cluster, hatching in a few days. Larva, first banded yellow and black; mature, 2 in. long, smooth clear light green, with 6 rows of tubercles with bluish circles around them and 1 yellow and 4 red tubercles. Young caterpillars crawl in groups and finally form pupae in silk cocoons wrapped in leaves and fastened by silk to twig for 3 weeks to over winter.

Food of adults, nothing; of caterpillars, leaves of cherry, sassafras, lilac, sycamore, tulip tree, ash, and others. In cocoons, females are heavier. Swinging cocoon difficult for birds to destroy.

Of little economic importance. Gut for fishing leaders may be had from caterpillars, but those from this species are relatively short.

Polyphemus Moth
Teles polyphemus

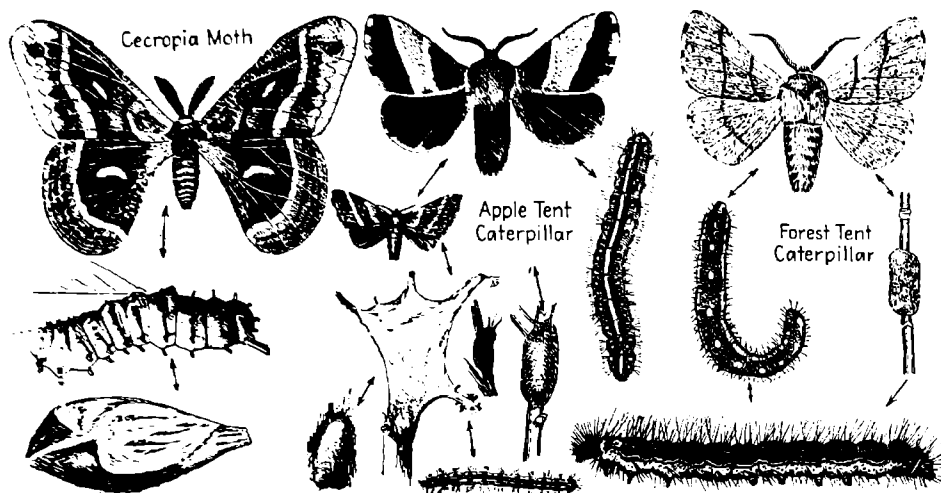
Wingspread to 6 in. Wings at rest held over back, like butterflies. Male, forewing buff, olive, or gray-brown, with transparent yellow-bordered eyespot; hind wing with dark border and blue eyespot, deeply black-bordered. Female much like male but with heavier body and with antennae not broadly feathered. Nocturnal.

Common throughout eastern United States and in northern Mexico wherever its food is available.

Over 300 cream-colored, disc-like eggs encircled with a brown band, usually laid on underleaf surface; hatch in 10-12 days into caterpillars that finally are green with reddish heads, conspicuously segmented, with rose-red or pale and silvery tubercles, bright red spiracles, and 7 oblique yellow lines on sides. Walking caterpillars may snap their jaws hard enough to be heard. Pupa in thick, strong, light-colored, oval cocoons, over winter.

Food of adults, nothing; of caterpillars, leaves of such trees as oak, elm, birch, and maple. Cocoons are made of a continuous silk thread that is exceptionally strong and might possibly be used as a substitute for silk from regular silkworm.

Always interesting to amateur collectors. Native silkworms, producing silk that has some commercial possibilities. Gut leaders may be made by pickling the caterpillars in saturated solution of salt and vinegar, removing the 2 silk glands, then stretching contained silk to length or thickness desired. Such leaders from cecropia moth (p. 409) may be 6-9 ft. long, able to sustain a 4-lb. pull.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Family Saturniidae

Family Lasiocampidae

Cecropia Moth
Samia cecropia

Wingspread to 6½ in. Wings usually held vertically. Male somewhat like female promethea but with large red and white crescent on basal half of each wing; abdomen red, banded with black. Female larger than male with more narrowly feathered antennae and with larger abdomen. Nocturnal. Mating takes place usually between 1 and 4 A.M.

Common wherever food plants are available from Atlantic Coast to Rocky Mountains.

Eggs to 400, egg-shaped, pinkish-white fastened with red-brown cement in rows of 3-20 on leaves of many plants; hatch in about 15 days. Larva black, then red; molts at 4, 5, 6, and 8 days; spins cocoon 10 days later. Mature larva blue-green with large yellow, red, and blue tubercles; about 4 in. long, matures in 4-9 weeks. Pupates in large tough spindle-shaped reddish cocoon fastened to twigs.

Food of adults, nothing; of larvae, leaves of box elder, apple, cherry, willow, plum, and about 50 different kinds of trees, so caterpillars can usually be reared easily with most tree leaves used as food.

Adults popular with amateur collectors. Larvae produce longest and best gut leaders of our native species (see p. 408).

Apple Tent Caterpillar
Malacosoma americana

Wingspread of male, 1¼ in.; of female 2 in. Rather stout, with reddish-brown body; forewings with 2 nearly parallel oblique whitish lines. Bodies may have banded appearance or be plain but are abundantly covered with hairy scales.

Found commonly on apple, cherry, and related trees in the Eastern States and Canada and west to Rockies, with some records from California. In northern part of range, adults appear late in June.

Female lays tapering-ended cylindrical bands of varnished eggs on twigs. Eggs about ½ in. long, 200 in mass, hatch with opening of leaves. Larvae begin feeding and making tent nest of silk; about 2 in. long, black with a continuous white stripe down back, and blue and white on sides. Remain larvae about 6 weeks. Pupae in 1-in. silk cocoons for about 3 weeks.

Food of larvae mostly apple and cherry but may also attack peach, pear, and plum. Tents provide shelter during larval stage. They do not do well in rainy seasons. Many parasitic enemies, and abundance varies from year to year.

Control by destroying nests, spraying as for codling moth or burning caterpillars and cocoons. One school of thought is that wild cherries should be preserved as a trap crop; another that they should be destroyed. Egg-collecting contests are popular.

Forest Tent Caterpillar
Malacosoma disstria

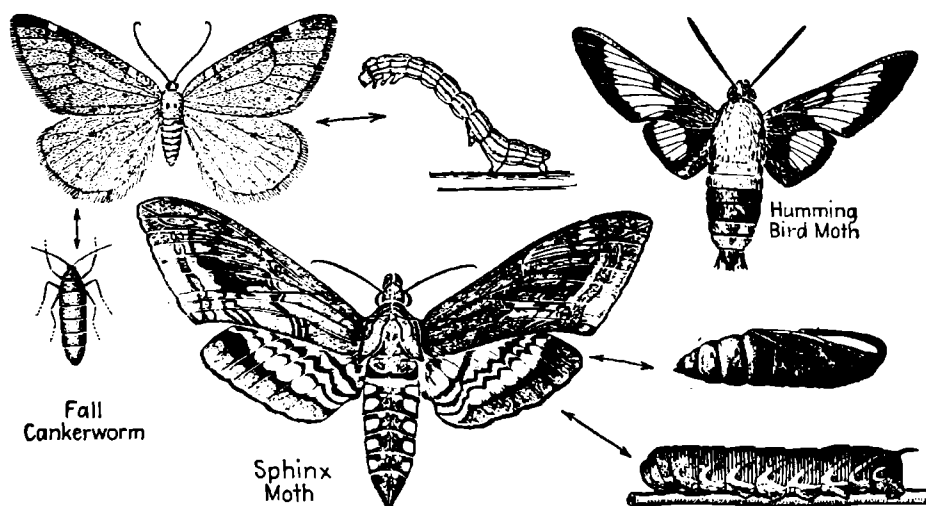
Wingspread slightly less than that of apple tent caterpillar. Differ primarily in that in forest tent caterpillar oblique lines on wings are dark instead of light, or very weak; and in larvae, white on back is broken rather than continuous.

Common throughout United States and into Canada and Mexico, being most numerous in forested areas, particularly where maple is abundant. Often a pest on shade trees along streets.

Eggs in blunt-ended cylindrical masses containing 150-400 eggs, on tree twigs in summer. Following spring, eggs hatch when leaves begin to develop. Caterpillars may form a silk carpet but build no tent; rather, they mass in great mats on trunks of host trees. Pupate in late May, emerge in late June, lay eggs in July; caterpillars develop in egg to August, hatching next spring.

Favors maple but eats leaves of apple, plum, peach, pear, cherry, and many other trees. Colonies of caterpillars break up as they reach maturity and wander off alone. Many parasitic and other enemies among the beetles, mites, wasps, flies, birds, amphibians, and other groups.

A spray of 8 lb. of lead arsenate to 100 gal. of water is effective. Campaigns to collect cocoons and egg masses are popular. Masses of caterpillars may be brushed up and burned or wandering caterpillars may be trapped on flypaper. Consult county agent or Experiment Station.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Family Geometridae

Family Sphingidae

1. Fall Cankerworm

Alsophila pometaria

2. Spring Cankerworm

Palaeocrita vernata

Wingspan male, 1-1½ in.; females practically wingless. Male of (1) darker smoky or brownish-gray, with a distinct whitish spot on front edge of forewing. Active mostly at night.

(1) found in injurious numbers through northeastern United States and even to western California. (2) more eastern in its distribution. Related species in Europe, the term *cankerworm* appearing in a Bible published in 1611.

Females of (1) climb trees November-April, mating and laying to 400 eggs in a mass, on twigs in treetops; hatch when leaves start. "Measuring worms" feed about 1 month before dropping to ground, by thread, to pupate 1-4 in. underground until emergence. (2) similar, but adults emerge March-April only.

Food, leaves of variety of woody plants, particularly shade and orchard trees. Caterpillars may be blown on silk to near-by trees that have not been infested by climbing females. Many enemies with birds such as thrushes, vireos, warblers, and chickadees ranking high. Many insect enemies also.

Artificial control by preventing wingless females from climbing trees to lay eggs, by use of barriers, tanglefoot fly-paper, or special proprietary mixture placed on trees from October through March for (1) and from February through April for (2). Arsenical sprays for codling moth will control on apple trees. Secure detailed information from your county agent or Experiment Station.

Sphinx Moth, Tomato Worm

Phlegethontius quinquemaculatus

Wingspread 4¼ in. Males ash-gray and streaked, with 5 pairs of yellow spots on conical body; wings narrow and pointed; tongue long; antennae thick and rough. Females, antennae thinner and smoother, as in hummingbird moths.

Found about deep-tubed flowers, particularly on summer evenings. This species common from Patagonia to Canada. About 100 species of sphinx moths found in United States.

Eggs large, green, spherical, shining, laid singly on leaves of food plants, hatch after a short period into green larvae that become about 3 in. long, stout, with a row of 7 shaded slanting stripes on each side, with an equal number of horizontal stripes making a V, and a good-sized rear horn. Larva to 4 weeks. Pupa in ground, over winter.

Food of larvae, leaves of tomato, potato, tobacco, and similar plants; of adults, nectar in flowers. Possibly 2 generations a year. Pupa like brown jugs, with long "handles" that contain tongues. Harmless to man; horns of larvae not poisonous as rumored.

Sometimes seriously destructive to host plants. Best control is by hand picking or by use of lead arsenate spray, 3-4 lb. to 100 gal. of water. Adults assist in pollination of some deep-tubed flowers. Consult county agent or Experimental Station for latest information on control.

Hummingbird Moth, Clearwing Moth

Hemaris thysbe

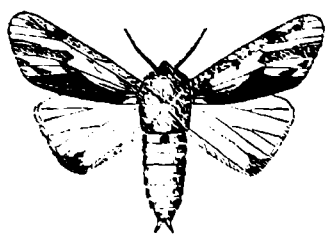
At rest, general outline, like an equilateral triangle, 1 in. on a side. Wings with conspicuous clear areas; scaly part of wings reddish-brown; hind wings much smaller than forewings. Rather large body well covered with hairy scales; conspicuous tuft at tip of abdomen.

Commonly found in flower gardens, clover fields, and similar places where nectar-bearing flowers are abundant. This species active in daytime. Another close relative is bumblebee hawk moth.

In June-July, larvae of these clearwings may be found on their food plants. They resemble, in general, other sphinx moth larvae, being light green with green pattern. Pupal stage spent on ground through winter in crude cocoon and without free tongue case common in related species.

Food of adults, nectar of flowers; of larvae, leaves of snowberry, viburnum, and their close relatives. Rapid erratic flight of adults always interests amateur insect collectors.

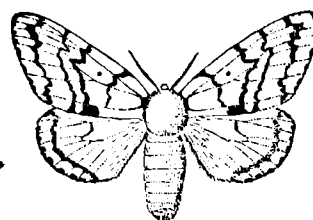
Of little economic importance because host plants are of secondary importance and larvae rarely, if ever, occur in sufficient numbers to be pests. 2 color forms (largely seasonal), either of which may be produced from eggs of other.



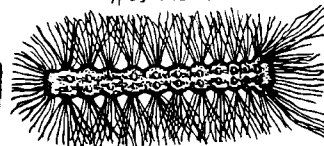
Red-humped
Appleworm



White-marked
Tussock Moth



Gypsy Moth



PHYLUM ARTHROPODA. CLASS INSECTA

Order Lepidoptera

Family Notodontidae

Red-humped Apple Worm

Scythris concinna

Wingspread 1½ in. Holds wings like sides of a roof. Males gray and white with brown along inner margin of forewings; hind wings largely white; basal half of antennae feathered. Female all dark-gray and brown, with hind wings gray; antennae unfeathered.

Common throughout United States, though adult is seldom noticed. Adult flies at night, usually during July, and remains hidden during day.

Eggs white, thin, smooth, finely sculptured, laid in clusters on food plants; hatch in short time into larvae, which live in colonies and are dirty orange when young and black and white when grown, with bright red heads and forward humps, black pegs on hump and body. Winter as caterpillars in cocoons, in trash on ground.

Food of adults possibly nectar; of larvae, leaves of apple, plum, maple, birch, and other trees. Caterpillars are able to throw acid, so should be observed with circumspection. Fortunately, they have many parasites.

Not commonly a serious pest and usually may be controlled by picking and burning larvae, particularly when they are found on newly set trees that have not become well established. May spray with 5 lb. of lead arsenate to 100 gal. of water. 1 generation a year in North, 2 in South.

White-marked Tussock Moth

Hemerocampa leucostigma

Wingspread of male, to about 1¾ in.; ash-gray, with front wings crossed by wavy dark lines and with conspicuous white mark near rear angle; antennae feathery. Female flightless, with mere wing stubs; light gray, usually found on old cocoon.

Widely distributed in United States and Canada, particularly in fruit-growing areas. Abundant, caterpillars and cocoons being found frequently.

1 brood a year in North, to 3 in South. Females emerge from cocoons in July, mate and lay to 500 eggs on old cocoon; cover these with a froth; hatch shortly or rest over winter. Larvae red-headed, with 4 even tufts of white hairs. Pupa after 4-6 weeks, in gray cocoon on trees; adults emerge after 10-15 days.

Food of caterpillars, leaves of apple, plum, pear, quince, and other fruit and shade trees, particularly horse chestnut, elm, and poplar. Hairs on back of caterpillar may cause a mild rash on some persons. May cause a 25% loss in apple crop.

May be serious pest on food trees. Natural enemies include dermestid beetle larvae, mites, and other parasites. Control by picking and destroying cocoons, banding trees to limit movements of caterpillars to new trees, and spraying leaves with arsenate of lead. Consult county agent or Experiment Station.

Family Liparidae

Gypsy Moth

Lymantria dispar

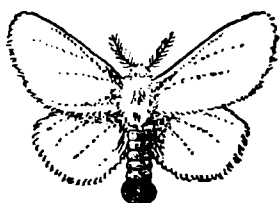
Wingspread to 1½ in. Male brown, with forewing crossed by 4 wavy dark-brown lines, body light brown. Female with light buff body; wings grayish-white with dark markings on forewings like those of male. Female larger than male.

Found too commonly on woody plants of New England area. A native of Europe, Asia, and northern Africa, where it has long been a tree pest. Introduced into Massachusetts in 1869 by a French naturalist who was experimenting with silkworms.

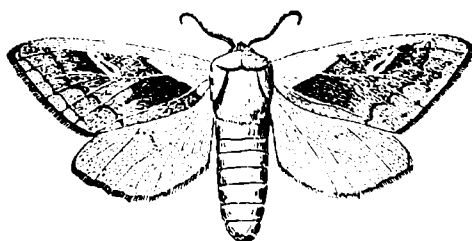
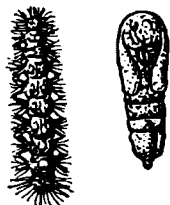
Winters as egg, in masses up to 500. As leaves open, eggs hatch into reddish-brown caterpillars that skeletonize leaves, avoiding sun and feeding largely at night, maturing in about 7 weeks as gray caterpillars 2 in. long with 11 prominent pairs of tubercles, first 5 blue, rest red. Pupa in frail cocoon about 17 days.

Food, leaves of most shade and fruit trees, even conifers; often so abundant as to defoliate trees completely. Male flies in zigzag manner but female, though winged, is unable to fly, so usually lays eggs on her cocoon. An important enemy is a ground beetle, *Calosoma sycophanta*.

Control is largely by picking and destroying egg masses, which are conspicuous during winter. Eggs destroyed also by painting with creosote and by closing cavities in which eggs are laid. Larvae destroyed by spraying leaves with 10 lb. arsenate of lead to 100 gal. of water. Consult county agent or Experiment Station.



Brown-tail Moth



Cattail Leaf-miner

Underwing Moth



PHYLUM ARTHROPODA. CLASS INSECTA

Order Lepidoptera

Family Liparidae

Brown-tail Moth

Euproctis phaeorrhoea

Wingspread about 1½ in., females larger than males. Wings white. Tip of abdomen with a tuft of brown hairs that gives insect its name; this tuft less conspicuous in male. Adult seen usually in July. Females good fliers, unfortunately.

Found on or near trees of various kinds. Native of Europe, where it has long been highly destructive. Now established from Nova Scotia and New Brunswick through New England and undoubtedly will continue to spread. Introduced near Boston in the early nineties.

Adult appears in July, and after mating lays to 300 globular yellowish eggs in ¾-in. long mass, covered with brown hairs, on underside of leaves; eggs hatch in to 20 days. Caterpillars brown with rows of white tufts on sides; feed in colonies and after 2-3 molts winter in groups in an egg-shaped shelter; in spring, molt 4-5 times, reach 1½-in. length. Pupa for about 20 days.

Food of larvae, leaves, particularly of apple, pear, and oak though many other trees are attacked. Unlike gypsy moth, they do not eat leaves of evergreens. Hairs on caterpillars may cause a severe rash on human skin.

Control most necessary; effected by encouragement of parasites and by collecting and burning hibernating caterpillars, also by use of spray of 8 lb. of lead arsenate to 100 gal. of water in August when caterpillars are youngest. Consult county agent or Experiment Station.

Underwing Moth

Catocala cara

Wingspread to 3½ in. Dark gray forewings that make a triangle when folded at rest. Hind wings normally hidden but black, pink-banded, and beautiful when flashed and displayed by placing forewings forward. Female slightly stouter and heavier than male. Found as adult in August-September.

Common over whole of eastern United States, with related species extending range throughout North Temperate Zone. About 200 species in United States in subfamily to which this moth belongs. This is among the most beautiful.

Winters as red egg, in clusters on bark of trees. In late spring, gray and black spotted caterpillars emerge, each with a fringe alongside making it appear flat and with a hump in middle of back; length when mature about 3 in. Pupa (which has a bloom) spends about 3 weeks between leaves, in a light brown cocoon.

Food, leaves of willow. Adults attracted to baits and feed on nectar. Larvae move by humping and jumping; have many insect parasites and other enemies.

Control is hardly necessary since insects are rarely sufficiently abundant to do any serious damage. Adults are so attractive that they are popular with amateur collectors. Ability of moths to vanish on a tree trunk is a marvel to all. Related to black witch moth of tropics.

Family Noctuidae

Cattail Moth, Cattail Leaf Miner

Arzama obliqua

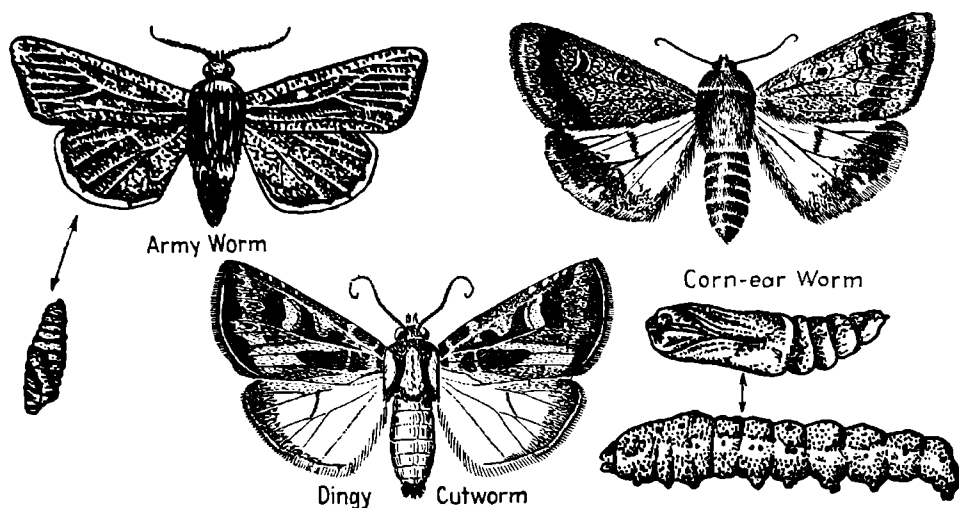
Wingspread to 2 in. Length to about 1 in. Forewings light brown with oblique brown stripe, hind wings with small dark spot. Presence indicated and easily detected by dead tops of infected cattails.

Found on or near cattails (see p. 98) throughout United States and Canada, wherever host plant may be found.

Eggs laid near tip of new cattail leaves in masses of 35-60, each mass with a waterproofing froth. Larva mines way down leaves as much as 20 in., molts, then abandons mine and enters stem as solitary borer; grows to length of 2 in., winters as larva. Pupal stage of 16-19 days begins in spring.

Food: young larvae eat soft interior of cattail leaf, working side by side. Older larvae, boring in stem, kill flower stalk and may otherwise injure whole plant. In central New York, eggs are laid in May.

Never of great economic importance because of small numbers and because of relatively secondary economic importance of host plant.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Noctuidae

Army Worm
Carpis unipuncta

Wingspread $1\frac{1}{2}$ in. Uniformly brownish-gray with tiny white spot near middle of forewing and rather conspicuous dusky outer margin on hind wing. Hind wings shorter than forewings.

Common over entire eastern United States west to Kansas and Nebraska, with some representation in Southwest and in California; related species all over world. Moths fly at night and are attracted by lights. Some 370 North American species in subfamily to which this insect belongs.

Eggs 50 to several hundred, laid on blades of grass and on similar plants, hatch in 8-10 days. Larva for 3-4 weeks; at maturity about $1\frac{1}{2}$ in. long, variable in color but commonly greenish-brown with a broad dark stripe along back and a dark stripe along each side; may migrate in great numbers. Pupae in ground a few days. Any stage may winter.

Food: in late spring, larvae favor grasses, particularly small grains. When abundant, larvae consume almost all available vegetation and move as an army to new territory, this being most common in July and August when second generation of larvae is developing. Many enemies, particularly tachinid flies, help control army worms.

At times this is one of most destructive of pests in grain-belt area. Controlled by ditches built as traps. Poisoned baits are also used when pests are not too abundant. Food strips in line of march are sprayed with poisons effectively. Consult county agent or Experiment Station.

Dingy Cutworm
Feltia duzens

Cutworm moths (of many species) are usually under 2 in. in wingspread. All are commonly gray to brown "millers," with lighter hind wings and darker banded forewings. Adults are commonly attracted to lights and fly at night, but this species may also fly in daytime.

Common in summer and widely distributed through America. This subfamily includes about 370 North American species that attack a great variety of plants.

In summer, fertile female lays her many eggs among grass roots; They are $\frac{3}{60}$ in. long, dirty white with brown markings. These hatch in a few weeks and caterpillars begin feeding, hiding underground in daytime. They winter underground, begin feeding again in spring, finally reaching $1\frac{1}{2}$ in. in length, with wide pale back stripe. Pupate underground about 4 weeks before emerging as adults.

Damage may be extensive, largely because of feeding of spring caterpillars on newly planted crops. 1 generation a year. Some related species attack trees, climbing them at night to feed and then returning to soil.

Control is by crop rotation, by late and deep fall plowing, by use of poisoned bran, and to a slight extent by trapping adults. 1 lb. of Paris green to 25 lb. of bran or middlings is applied a few days before new plantings are made, or 1 tbsp. is placed at 3-ft. intervals in rows of crops. Consult county agent or Experiment Station.

Corn-ear Worm
Heliothis obsoleta

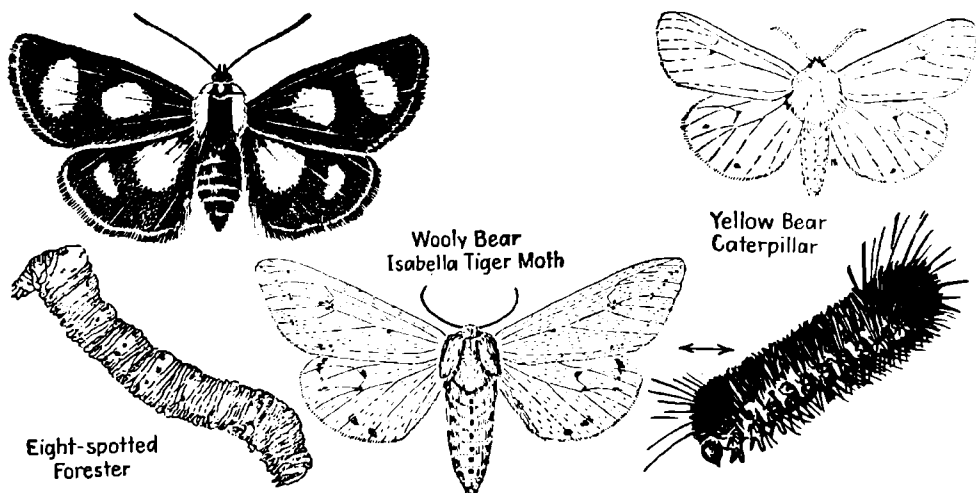
Wing span about $1\frac{1}{2}$ in. Extremely variable. Some dull olive green, others yellowish or brown with almost no markings. Hind wings cream-colored, with black border containing a pale spot.

Common, particularly in South, but found rather generally over United States wherever corn is grown.

Many light yellow, spherical, prettily corrugated eggs are laid on corn, tomatoes, cotton, beans, and so on. These hatch in 3-5 days and develop into variable light green to black, plain or mottled caterpillars that become full-grown in $2\frac{1}{2}$ weeks at a length of $1\frac{1}{2}$ in., and then leave corn to burrow in soil and pupate 2 weeks or over winter as 1-in. shining red-brown pupae.

Food of larvae, fruits and other plant parts of corn, cotton, beans, peas, and other garden crops. Adults feed on nectar and do no direct damage. 1-2 generations a year; type of food determined largely by plants available at time it is needed.

Control is by late fall plowing, by planting corn early, by use of lead arsenate spray to control at least first generation. Destroy about 3% of green corn crop annually and make it difficult to raise this crop at all in South. Consult county agent or Experiment Station.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Family Agaristidae

Eight-spotted Forester
Alypia octomaculata

Wingspread to $1\frac{1}{4}$ in. Black with 2 yellow spots on each forewing and 2 white spots on each hind wing. Legs yellow-orange. Abdomen of male distinctly tufted. Female larger than male, abdomen not tufted.

Common on porches or places where woodbine grows, throughout United States east of Rocky Mountains. Presence usually indicated by droppings of caterpillar. Only 16 North American species in the family.

Female lays many eggs on woodbine and grape. These hatch in a short time and develop eventually into humped caterpillars with small black knots on rear, about 6 cross stripes to each segment, orange heads, and a big white spot on side of tails. When ready to pupate, larvae eat a burrow into wood and remain as pupae over winter.

Food of larvae, leaves of woodbine and grape, sometimes to such extent as to cause injury. Usually 2 broods a year; adults appear in May and August and larvae in June, July, and September.

Not normally injurious but where they are troublesome may be controlled with usual sprays that serve as stomach poisons.

Isabella Tiger Moth
Isia isabella

Wingspread to 2 in. Male buff brown with small black spots. Hind wings straw-colored. Body dirty orange with black spots. Female similar or with flesh-colored hind wings. Commonly flies at night and attracted by lights.

Common in northern United States from Atlantic to Pacific. Best known in caterpillar stage as a "woolly bear," seen crossing roads in fall.

Females lay nearly 1,000 yellow, spherical, slightly spaced eggs in patches. These hatch shortly into furry red-brown caterpillars with black ends; when very young, they are social; when grown, they may lose much of black ends. Winter as caterpillars under rubbish, feed in spring, then pupate under cover in cocoons made of silk and caterpillar hairs for about 2 weeks.

Food of caterpillars, a variety of plants, with preference limited only slightly. Cocoons are found so commonly under stones and boards that they are well known. Probably no relationship between length or severity of an approaching winter and proportion of black on caterpillars. Young have more black than old; early cold weather may send more of these darker than usual caterpillars in search of winter quarters, so that they are noticed; yet this is result of existing conditions, not of coming ones.

Of little or no economic importance since they do not specialize on useful plants and are rarely if ever sufficiently abundant to do serious damage to anything. Skunks and some other animals roll hairs off caterpillars before they eat them.

Family Arctiidae

Yellow-bear Caterpillar
Spilosoma virginica

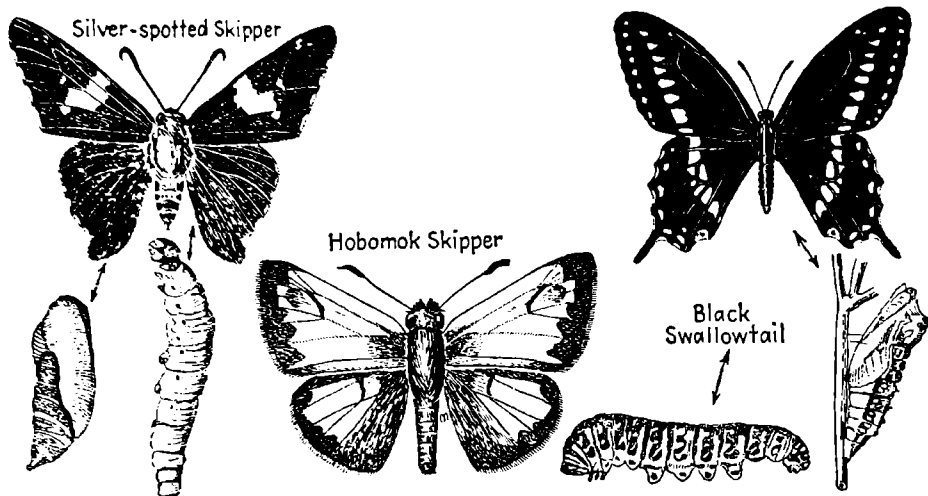
Wingspan to $1\frac{1}{4}$ in. Male white with a few small black dots. Wings held like a roof gable. Body white with yellow side stripes. Front legs with yellow stripe. Antennae broad. Female similar but antennae not plainly feathered.

Common throughout temperate America. Family includes nearly 200 North American species, more than half of which are true tiger moths. Related species are harlequin milkweed caterpillar, bella moth, salt-marsh caterpillar, hickory tussock moth, and fall webworms.

2 generations a year. Female lays several hundred yellow spherical eggs, slightly spaced, on anything. Hatch in 4-5 days. Caterpillars social when very young, later variously colored with long soft loose hairs which give body a cream to black appearance. Winter as pupae. Pupae in felty cocoons, 2 weeks to over winter, under trash.

Food of caterpillars, almost any vegetable materials that may be available; confined to low plants. Loose hairs on caterpillars serve as protection whether they are stiff as in Isabella or soft as in this species, since they break off and are unpleasant to many potential enemies.

Of little economic importance. Sometimes they have been known to eat silk off corn, thus reducing effectiveness of pollination.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Family HesperIIDae

Silver-spotted Skipper

Epaenareus tityrus

Wing span to 2 in. Wings often held half-open. Male, forewings brown, with tawny spots above and beneath; hind wings with silver splash on underside and unmarked above. Female lacks a slender fold found along forward edge of forewing of male. Fold in forewing is a scent organ. Alert insects.

Fairly common in all of temperate North America, ordinarily found near such plants as locust and wisteria. Adults in June-July. Over 80 species of subfamily in America north of Mexico.

Winter spent in pupal stage, with 1-2 generations a year. Adults emerge in late spring or early summer, mate, and lay eggs. Eggs dome-like, heavily ribbed, grass-green, laid singly on upper leaf surfaces, hatch in about 4 days. Larvae yellow and green with fine cross stripes; head large and brown with 2 orange spots; neck narrow; make nests of leaves and silk; nearly 1½ in. long. Pupate between leaves on ground.

Food of larvae, leaves of locust, wisteria, and other (usually woody) legumes. Winter pupal stage in this species is rather unusual for members of group. Pupa nearly 1 in. long, obscure brown, with abdominal portion not so long as rest of body.

Adults attractive and, while larvae may be injurious to host plants, they are never sufficiently abundant to be considered serious pests.

Hobomok Skipper

Poanes hobomok

Wing span to 1¾ in. Wings often held half-open. Male, forewings tawny with irregular blackish border; hind wings lemon-yellow beneath with broad irregular brown edge. Female coarser and heavier. 2 forms of female: one, like male, other, with black forewings with small white spots, and chocolate underneath center of hind wing.

Abundant in Northeastern States, in grasslands, June-July. Skippers have widely separated antennae enlarged at tip into knobs. Bean leaf roller is a member of this family.

1 generation a year. Females in early summer lay many smooth hemispherical pale green eggs on grass. These hatch in 11-13 days and develop into slender yellow-brown, naked-bodied caterpillars with dark dorsal and lateral stripes and a narrow neck; head large and tapering. Larvae make web nest in grass; winter as mature larvae. In spring, short pupal stage is spent in cocoon in grass. Pupa about 1 in. long, soft, long-tongued.

Food of larvae, grass; of adults, nectar.

Of little economic importance since they are never abundant.

Family Papilionidae

Black Swallowtail

Papilio polyxenes

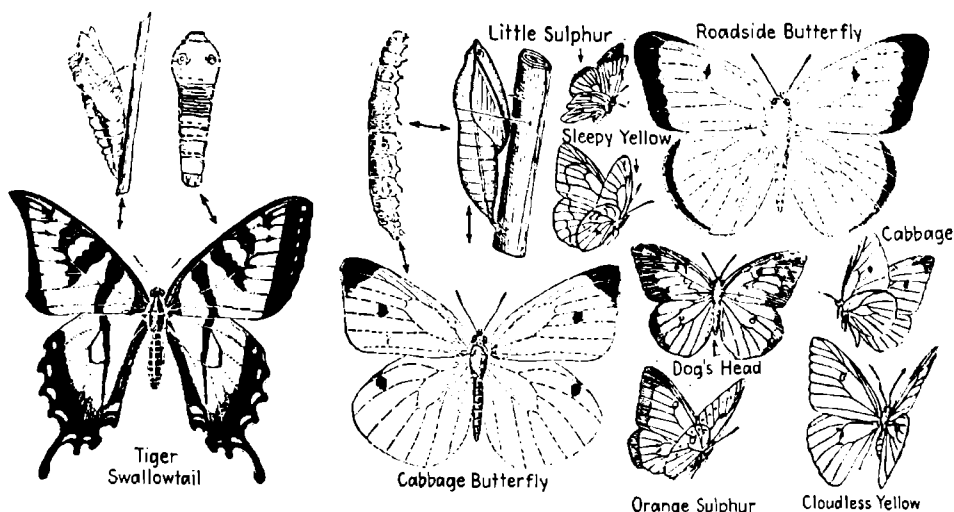
Wing span to 4 in. Wings held erect when at rest. Male, wings black, with double border of yellow spots, those on hind wings orange beneath with single row of blue ones between; "tails" of hind wings ½ in. long. Female like male, but with yellow spots smaller, blue spots larger, and without extra spot in cell of hind wing.

Common in all of United States and in southern Canada, with special varieties from Quebec to Cuba and Colombia; in gardens and fields where food plants are being raised, from May-September in North.

Winters in pupal stage. Adults emerge in May, mate, and lay smooth round plain yellow-brown eggs, singly, on underside of food leaves. These hatch in 5-10 days and develop into green caterpillars ringed with black and spotted with yellow when mature, spined and with a white saddle when young; length nearly 2 in. Pupae for 9 days or over winter, erect on plants or boards, attached at tail and with loop of silk above.

Food of larvae, leaves of carrots, parsnips, caraway, and related plants. Larvae have an offensive odor when disturbed and a perfect concealing pattern that provides good protection.

Larvae may be injurious to some crops but are easily controlled by hand picking, since they are rarely abundant. Adults are a pleasure to see. Caterpillars are harmless in spite of their rather startling appearance.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera

Family Papilionidae

Tiger Swallowtail
Papilio glaucus turnus

Wing span to 5 in. Male, forewings yellow with a black border and black cross stripes, border containing yellow spots; hind wings with $\frac{1}{2}$ -in. tails. Female larger than male, with broader black stripes and without claspers which are easily seen on end of male's abdomen.

Common in most of United States and in southern Canada but not on West Coast. Found in a great variety of places but generally favors open sunny areas.

Winters in pupal stage. Adults emerge from May–September, mate and lay smooth green spherical eggs singly on upper surfaces of food leaves, eggs hatch in about 10 days. Larva green, with 2 large eyespots at front end, followed by a yellow crossband; ugly-looking and vicious-acting, because of eyespots and 2 soft orange processes forced out when disturbed; length 2 in. when mature.

Food of larva, leaves of birch, poplar, ash, and cherry. Pupal stage lasts 2 weeks or over winter; pupa $1\frac{1}{4}$ in. long, wood-brown, straighter than that of black swallowtail, hanging erect in a thread loop usually away from host plant.

This species of little if any economic importance, but adults are insects of beauty admired by all who care for butterflies.

Cabbage Butterfly
Pieris rapae

Wing span to 2 in. Male, forewings white, black-tipped above, with 1 black spot that is sometimes absent in spring; hind wings white above and yellowish beneath. Female, forewings as in male but with 2 black spots that may be smaller in spring; hind wings as in male. Wings folded when at rest, open when alert.

Very common but limited essentially to Temperate Zone. Found mostly about gardens, flower beds, and fields where its food crops are being grown. 3 groups of family are recognized in eastern United States: the whites, the yellows, and the orange tips. A dozen whites in North America.

Winters as pupa or adult. In North, 3 generations a year; in South, to 6. Eggs yellow, flask-shaped, with 12 vertical ribs, laid singly, usually on undersurfaces of food leaves, hatch in 1 week. Larva green, with fine hairs and with yellowish backband, 1 in. long, maturing in 2–3 weeks, then forming pupa that lasts from 10 days or over winter. Pupa green, slender, $\frac{5}{8}$ in. long, angular.

Food primarily cabbage, and closely related mustards. Caterpillars eat through leaves into heads of cabbage. Introduced into America in 1866. Affects chickens that eat it.

Control is commonly by hand picking and by spraying. Consult your county agent or Experiment Station for latest information on control.

Family Pieridae

Clouded Sulphur (Roadside) Butterfly
Eurymus philodice

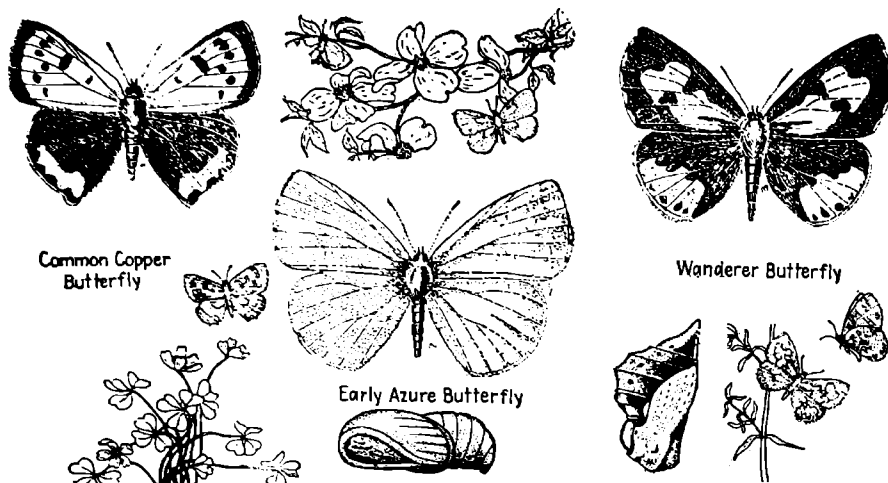
Wing span to $2\frac{1}{2}$ in. Male, forewings yellow above and with narrow black border. Female with broader borders and usually containing yellow spots. 2 kinds of females, one yellow, other white.

Common along roadsides; males in flocks about muddy spots, often closely crowded together. From St. Lawrence River south to South Carolina and west to Rocky Mountains. Closely related orange sulfur butterfly, *E. eurymene*, is found west to Pacific, in Southwest, and east to Maine.

Eggs pale yellow changing to crimson, slender, laid singly on clover and other legumes, hatch in 4–5 days and develop slender green caterpillars, with longitudinal stripes, heads lighter than body, covered with fine hairs; length more than 1 in. Winters in various stages. Pupates for as short as 10 days; pupa pale green, pointed, not angular, $\frac{3}{4}$ in. long, with narrow yellow stripe.

Food; larvae feed on clovers and other legumes. Orange sulfur butterfly or alfalfa caterpillar is frequently a pest on alfalfa, particularly in West.

Not usually abundant enough to need control. Adults always interesting; thought by some persons to provide suggestions for compass direction. This hardly seems dependable; probably as fallacious as ability of daddy longlegs to locate cows.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Lycaenidae

Common Copper Butterfly
Lycaenopsis taphroclaeus

Wingspread to $1\frac{1}{2}$ in. Wings commonly closed when at rest. Male, forewings copper-colored above, with black outer border; hind wing black above, with red outer border. Female like male but with more rounded hind wings.

Common through summer months, found mostly on lawns and fields where its food plant occurs. Common from Atlantic to Pacific, along northern border of United States, south to Gulf States area.

Eggs pale green, nearly hemispherical, with large white-walled cells; many laid singly on stem or leaf of sorrel, hatch in 6-10 days. Larva small, stocky, with head and naked body green with a dusky line on back, darker and sometimes rosy on middle of sides, $\frac{3}{8}$ in. long. Pupates under stones for 9 days or over winter.

Food of larva, leaves and stems of sorrel; of adult, nectar. Pupa light brown to green, with black dots, $\frac{3}{8}$ in. long, stocky and smooth. Adults, larvae, and pupae are mostly inconspicuous when at rest, though adults are beautiful when active.

Control unnecessary or undesirable, since food plant of larva is generally considered an objectionable weed. Numbers are insignificant, anyway.

Early Azure Butterfly
Lycaenopsis argiolus

Wingspread to $1\frac{1}{2}$ in. Male, forewings pale blue above, earlier butterflies more heavily marked with dark on whitish undersides. Female paler blue with broad dark margins.

Common in fields, woods, and roadsides from April-August, in United States, Canada, the Old World, and Mexico. Characteristic of family is that front legs of male lack claws. Subgroup, the Blues, is represented in North America by 38 species, mostly western.

2-3 generations a year. In April, female lays many short thick green eggs, singly, in flowers of dogwood, black cohosh, or other flowers. These hatch in 4-8 days. Larva stocky, $\frac{3}{8}$ in. long, naked-bodied, white, with a dusky back line and small dark-brown head. Pupa stocky, $\frac{1}{2}$ in. long, light brown to yellow with black marks, 10 days or over winter.

Food of larvae, flowers and fruits of its food plants. Rarely sufficiently abundant to be considered pests.

Of no economic importance.

Wanderer Butterfly
Peniseca tarquinus

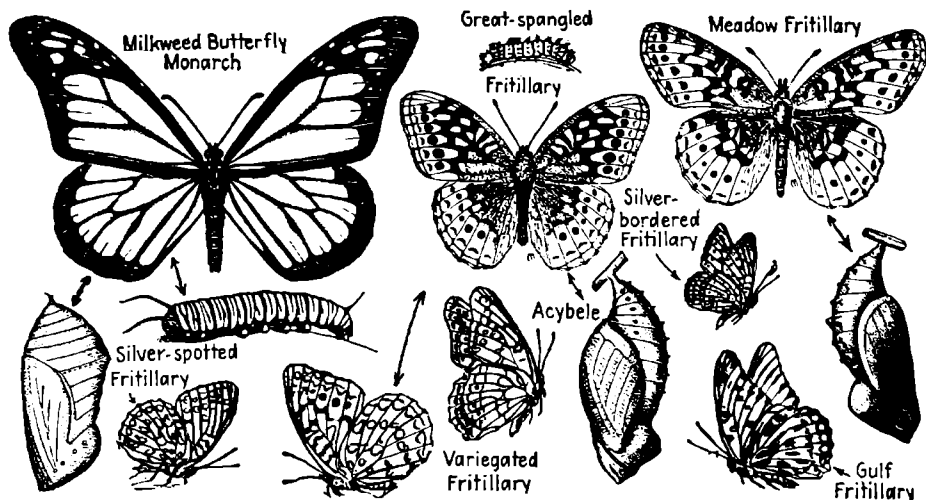
Wing span to $1\frac{1}{4}$ in. Male, forewings tawny with black markings; hind wings with rear half tawny and forehalf black. Female a little more orange than male.

Common in eastern United States but rarely abundant and probably not recognized by most people. Family is known as "gossamer-winged butterfly family." It includes the coppers, the blues, and the hairstreaks as well as the wanderer. Frequent in alder swamps from June-September.

Winters in pupal stage. In June, adults emerge, mate, and female lays many flattened spherical faintly green eggs, singly, near a colony of alder-blight plant lice. Eggs hatch in 3-4 days. Larvae plump, with small heads, covered with a whitish bloom; bury themselves under a web and dead bodies of aphids. Pupa short, thick, looks like monkey face; hangs on branch for 2 weeks or over winter.

Food: caterpillars feed solely on aphids in colony in which placed by female. This habit of eating other insects is unique; most other butterfly larvae feed on plants.

These insects merit encouragement since they prey upon other insects which damage reasonably useful plants. However, none of them plays an important role in man's economy.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Nymphalidae

Milkweed or Monarch Butterfly
Danaus plexippus

Wing span to 4 in. Upper surfaces of wings light reddish-brown with black veins and borders and with 2 rows of white spots on outer borders. At rest, wings are held above back, with hind wings covering most of forewings. In male, each hind wing has a black scent gland, as shown.

Common in most of United States, in fields and along roadsides, sometimes migrating in great flocks that may settle on a single tree, weighing it down. Family includes most of our more attractive butterflies. This species is in subfamily Danainae.

Eggs green, flask-shaped, with lines of pits, laid on milkweed leaves, hatch in about 4 days. Larva yellow with black cross marks and a pair of slender movable threads at each end. Molts, 4, in about 10 days. Pupa pale green spotted with black and gold, free-hanging from a thread, about 12 days.

Food of larvae, leaves of milkweed. Larvae and adults reputed to be distasteful to birds. Big fall migrations to South are observed. Northern migration may be merely moving of individuals into new territory. May be 3 weeks from egg to adult.

Since food plant is milkweed, which is not normally considered of economic importance, this butterfly can hardly be considered harmful to man's interests. Its migration habits are not completely understood, but its beauty as a pupa and adult is thoroughly appreciated.

Great Spangled Fritillary
Argynnis cybele

Wing span to $3\frac{1}{2}$ in. Male, forewing orange-brown with numerous black markings, hind wing with broad yellow stripe and brown hair fringe above, and round silver spots beneath. Female like male, except that half of wings next body on upper side is dark, while in male it is only slightly so; hair fringe lacking.

Common about fields in late summer, particularly where weeds are likely to be tall; ranges through eastern United States west to Great Plains. Name fritillary refers to dice-like spots on wings. 2 commonest species are great spangled and variegated fritillaries.

Eggs short, rounded, higher than broad, ribbed, honey yellow, laid singly near food plants; hatch in about 15 days. Larva at first rough, warty, greenish-brown; winters as just-hatched caterpillar, then matures following spring, becoming black, $1\frac{1}{2}$ in. long, with branching spines in rows. Pupa hangs for 14-24 days.

Food: larvae eat leaves of violets at night, spend day in hiding. Adults eat nectar from flowers. Pupa about 1 in. long, roughened, brown, coarsely wrinkled, and inconspicuous.

Since food of larvae is wild violets, not considered of economic importance, these butterflies are not classed as pests. They are always beautiful to watch as adults.

Marsh (Meadow) Fritillary
Brenthis bellona

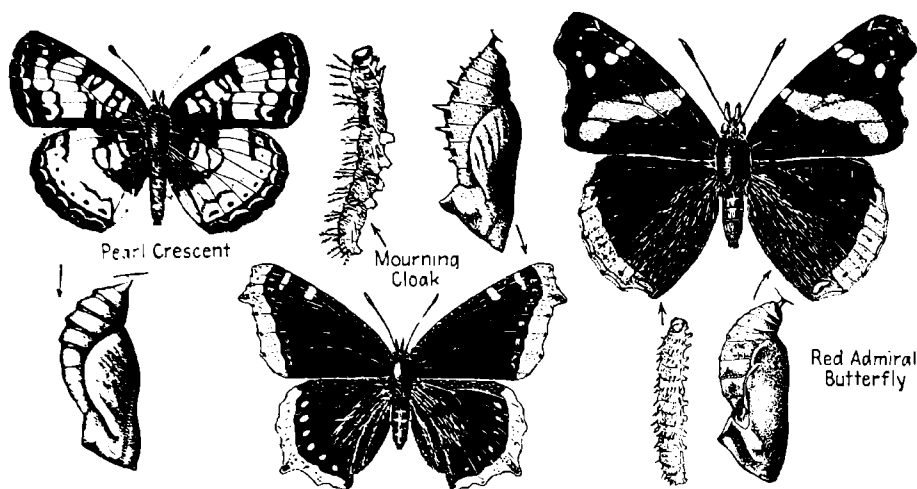
Wing span to $1\frac{1}{2}$ in. Female larger than male and darker, orange-brown, with numerous black markings. No silver markings beneath such as are to be found on great spangled fritillary and on small silver-bordered fritillary, *B. myrina*.

Common in wet fields, in summer and fall, ranging throughout Canada and Northern States, west to Rocky Mountains and south into Carolinas. 17 North American species in genus, most of them arctic and limited to higher mountains. *B. montinus* of White Mountains, N.H., is one of these.

1-3 generations a year. Eggs tall, dull olive, prominently ribbed, laid singly on food plant, hatch in 5-9 days. Larva spiny, nearly 1 in. long, olive-brown with green markings; winters as half-grown caterpillar. Pupa about 1 week.

Food: leaves of violet, eaten at night. Adult feeds on nectar and, in East, seems to favor asters. Pupa bluish-gray with dark spots and with 2 rows of small cones on back. Adults gay little butterflies, common near centers of human population but near wet places.

Of little or no economic importance, apparently, since food plants are chiefly wild violets.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Nymphalidae

Pearl Crescent
Gestonina leucophaea

Wing span to 1 $\frac{1}{2}$ in. Male, wings dull orange with broad black margin and spots; hind wing with small pearl-gray crescent on lower surface; in spring, marbled cream and brown; in summer, yellow with brown marginal patch. Female larger than male.

Common about lawns and gardens in late spring and summer. 10 species of crescent spots in America north of Mexico. Included in these are West Coast meadow crescent, Rocky Mountain (Canada to Texas) Camillus crescent, and eastern Bates's crescent.

Eggs light yellow-green, taper-pointed and less than twice as high as broad, laid in clusters of 25-200 under leaves of food plants; hatch in 5-10 days. Larvae scatter after hatching; have several rows of little soft spines. Head spineless, dark-mortled. Winter as young caterpillars $\frac{3}{4}$ -1 in. long. Pupate 16-14 days.

Food of adults, nectar; of larvae, asters, particularly New England aster, on which plants larvae are expert hiders. Pupa hangs by tail safely in these plants, is variously colored, with gray-brown creases and a length of $\frac{3}{8}$ in.

Of no economic importance since it preys almost wholly on plants ordinarily considered weeds.

Mourning Cloak, Yellow Edge
Aglais antiopa

Wing span to 3 $\frac{1}{2}$ in. Male, forewings maroon with broad straw-yellow border, blue spots on upper surface, and almost black beneath; hind wings like forewings, but with suggested "tails." Female similar to male. A rare variety has straw-colored border reaching mid-wing.

Common throughout year, often seen in winter, and not infrequently coming into houses. Most common near woodlands from June-August, ranging from southeastern Canada through Middle States, where there are 2 broods a year. May be found between Arctic Circle and 30°N.L.

Eggs dark-brown or black, barrel-shaped, laid in rings around twigs, hatch in 9-16 days. Larva 2 in. long; head angled; head and body, black; body spined and white-spotted, with red on middle of back; prolegs reddish; group of larvae stays together. Pupa on twigs, 8-16 days, dark-brown with red-tipped swellings, often with whitish bloom; over 1 in. long.

Food of larvae, leaves of elm, poplar, willow, hackberry, and other trees; of adults, nectar. One of tortoise-shell butterflies, adults of which hibernate, restricted to North Temperate Zone except for colder mountains of subtropics.

Sometimes considered pests, but only rarely. May be controlled where abundant by picking off egg masses on twigs of food plants.

Red Admiral Butterfly
Vanessa atalanta

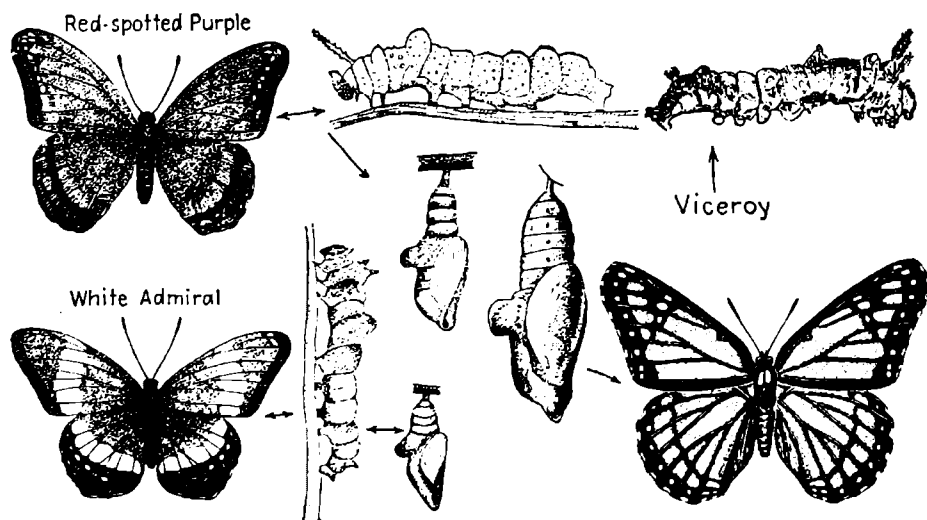
Wing span to 2 $\frac{1}{2}$ in. Male, forewings black with white markings at tip and a red crossbar; hind wings dark-brown with red border speckled with black and blue. Hind wings of red admiral and painted ladies not angular as in tortoise shells, though both have been placed in same genus.

Common over open grounds from May to winter throughout temperate North America, Europe, northern Africa, and temperate Asia. 25 species of anglewings in America north of Mexico, including red admiral, tortoise shells, painted beauty, and mourning cloak. Most species have wide range.

Eggs barrel-shaped, delicate green with fine ribs, laid singly on upper surfaces of food leaves, hatch in 5-6 days. Larva with spines and hairs about $\frac{1}{2}$ spine length, head rounded, color variable, length about 1 in.; spines relatively not so large as on larva of mourning cloak. Pupa from 10 days, on.

Food of larva, leaves of nettles, hops, and their close relatives; of adult, nectar. Pupa resembles that of mourning cloak but is slightly smaller, measuring about $\frac{3}{4}$ in. Ash-brown with dark markings and golden spots; hangs on plants.

Of no economic importance because food plants are not normally valuable. Adults are attractive and admired by naturalists.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Lepidoptera. Family Nymphalidae

Red-spotted Purple
Basilarchia astyanax

Wing span to $3\frac{1}{4}$ in. Male, forewings black with border of blue dashes and orange spots beneath; hind wings like forewings except that outer half is washed with green or blue. Both sexes show orange spots on undersides of wings, general color there being brown.

Common all over United States and Canada west to Rockies, but more uncommon in Gulf States area; occurs in highlands of Mexico; commonest June-August. Close relatives include white admiral and viceroy.

Eggs globular, yellow-green to dark-brown, many, laid singly on leaves of food plants; hatch in 7-9 days. Larva, body naked, humped, irregular, streaked, with a pair of rough black clubbed horns and many minute wart-like structures over back; resembles bird dropping; $1\frac{1}{2}$ in. long; winters as small caterpillar in silken tube. Pupa 10-12 days.

Food of larva, leaves of plum, apple, pear, and gooseberry, but rarely sufficiently abundant to be considered a pest. Pupa queerly colored, yellow, brown, olive, and salmon; glossy and nearly 1 in. long.

Control not necessary because of relatively small numbers at any one time. Adults so attractive that they are prized by collectors.

White Admiral Butterfly
Basilarchia arthemis

Wing span to $2\frac{3}{4}$ in. Wings in general black with a broad white band crossing them from front to rear; band may become narrow or even lacking in some individuals. Underwings as in preceding species, but spots rusty red.

Common from Alberta, Ontario, and Quebec through New England to Pennsylvania, and in higher mountains farther south; not recorded in West but replaced there by a similarly marked *B. weidemeyeri*, which is found east to western Nebraska. Closely related to red-spotted purple butterfly.

Eggs and other immature stages indistinguishable from those of red-spotted purple.

Food of adult, nectar; of larva, leaves of willow, basswood, and birch. Undoubtedly comes from same stock as red-spotted purple, and in territory where this northern species meets that southern species, individuals may be found having characters of each.

Of little economic importance, but of considerable importance to naturalists who are interested in interrelationships of species and relation between range and persistence of given characters.

Viceroy Butterfly
Basilarchia archippus

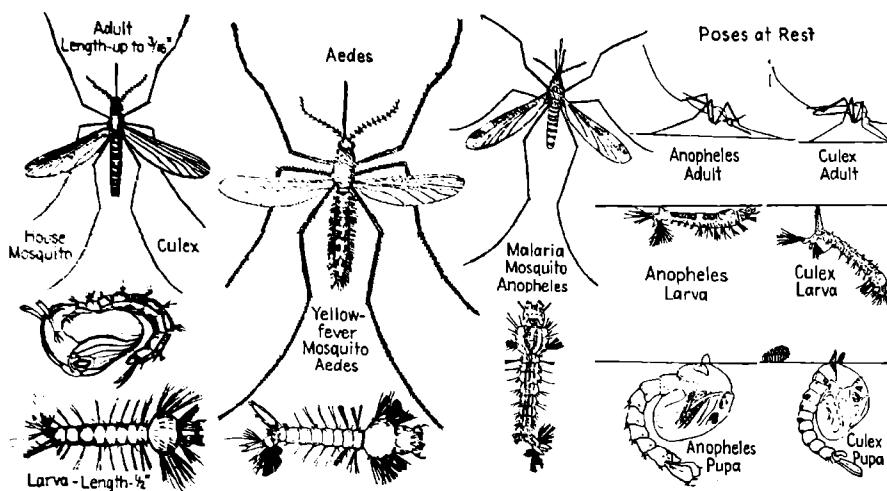
Wingspan to $3\frac{1}{2}$ in. Male, forewings orange-brown with white-spotted black border and conspicuously black veins; hind wings like forewings, but with extra black crossband about as wide as veins. Female like male but larger. Viceroy resembles monarch except that it is smaller, has extra band on hind wings, lacks male's scent gland, and has one less row of white spots in border of wings.

Common, particularly in open fields during August-September, from Canada to Gulf of Mexico. Close relative of red-spotted purple and white admiral butterflies.

Eggs deep green, globular, pitted, laid singly on upper or under leaf surfaces of food plants, usually at tip of leaf; hatch in 4-8 days. Larva resembles bird dropping, irregular, warty, with a pair of long clubbed prickled tubercles near front, black, over 1 in. long; winters as caterpillar. Pupa hangs on a tree, 7-10 days.

Food of larva, leaves of willows, poplars, and aspens; of adult, nectar. Pupa resembles that of red-spotted purple, being glossy and queerly colored yellow, brown, olive, and salmon.

Of little or no economic importance. Interesting because of mimicry of monarch butterfly; latter reputed to be avoided by enemies because of unpleasant scent, and viceroy apparently benefits from this immunity of monarch.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Diptera

Adults have 1 pair of wings, or none, hind pair of wings being represented by a pair of balancing organs, which is always present; mouth parts sucking, lapping, or piercing, larvae worm-like, without jointed thoracic legs and usually legless.

Family Culicidae. MOSQUITOES

These small flies have narrow wings, with a fringe of scale-like hairs on hind margin of wings and on some veins. Antennae of males bushy, of females less so. Proboscis usually long and firm. Abdomen usually long and slender.

House Mosquito *Culex pipiens*

Female $\frac{1}{8}$ in. long with wings slightly shorter; proboscis slender, brown, dark at tip; abdomen black with bluish to bronze reflection, held parallel to support when at rest; legs long, slender, brown-scaled, hind pair curved upward when at rest.

Found everywhere in eastern North America and on Pacific Coast, common in other parts of world with similar climate; with closely related species extending range to all parts of world. Commonest, of course, near large areas of stagnant water.

Eggs laid in rafts of 100-300, floating on water, hatch in 1-5 days. Larva a wriggler that in 1-2 weeks becomes a pupa; larva at rest hangs at an angle from water surface, breathing through rear. Pupa active, more compact than larva, more erect than that of *Anopheles*, lasts for a few days. Winters as adult.

Food of larva, minute animals and plants in water; of female adult, blood of animals; of male adult, plant juices. A troublesome pest. Can carry filariasis. Active day or night but feeds mostly during evening and early morning. Related mosquitoes may go long distance from breeding area.

Control essentially by draining or using larvicides in breeding areas. Screening, spraying possible hiding places with DDT, and swatting represent other means. Excellent repellents (such as 6-12 and dimethylphthalate) are now available at any drugstore.

Yellow-fever Mosquito *Aedes aegypti*

Female, length $\frac{1}{8}$ in., wings slightly shorter; proboscis slender and black; abdomen black, each segment except last with basal row of white scales and a small silvery spot on each side; top of thorax with 4 narrow silvery-white lines, outer pair curved; legs black with white bands; wing scales brown.

Found in tropical and subtropical regions, most commonly about human habitations and breeding normally in artificial containers, rarely in natural water holes. Rarely far from human habitation. In summer, range may be extended northward.

Eggs laid singly, on or close to water, hatch in 10 hours to 3 days. Larva hangs downward, growing for week or 10 days before pupating. Pupal stage lasts 2-3 days. If adult has fed on blood of yellow-fever patient during first 4 days of his illness, it can transmit disease to others after about 12 days and continue doing this as long as it lives.

Adults fly by day, bite fiercely but attack quietly, though sharp high note can be heard; attack from behind or beneath, crawling into clothing to reach suitable spot. Principal carriers of yellow fever; also dengue, filariasis, and other tropical diseases.

Control is by destruction of breeding places, screening, and spraying indoors to leave a residual film.

Malaria Mosquito *Anopheles quadrimaculatus*

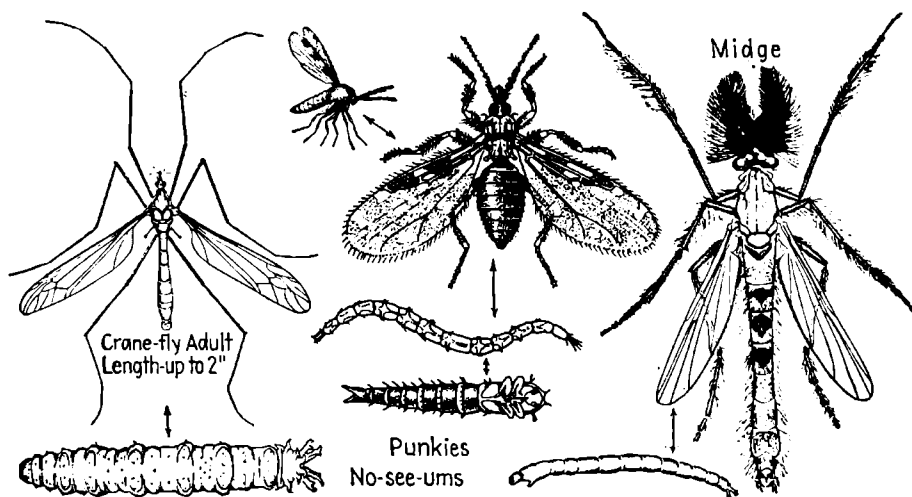
Female to $\frac{1}{8}$ in. long; antennae almost black; abdomen blackish with pale and black hairs; black scales on wings form 4 distinct spots; no coppery spot at wing tip; legs slender and black; abdomen held at an angle of 45° when at rest, hind legs extended in same direction.

Found from Mexico north through Mississippi Valley into Canada and east to Atlantic, but becoming rare in northern part of range. Other related species, however, are fully as dangerous and extend range.

Eggs laid singly, on surface of water, hatch 2-3 days later. Larva resembles house mosquito but lacks breathing tube at rear end and hence rests parallel to water surface rather than at an angle; period lasts about 2 weeks. Pupal stage 2-3 days, active. New generation every 3 weeks. Winters as adult.

Female feeds on blood during twilight and early morning. Malaria of different types caused by protozoan *Plasmodium* of different species. As plasmodia escape from red blood cells, patient has chills, followed by fever; at intervals of 2 days, in tertian type (commonest in North America); of 3 days, in quartan type; at variable times, in aestivo-autumnal type.

Control, as in other species.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Diptera

Family Tipulidae

Crane Fly
Tipula sp.

Crane flies are commonly suggestive of gigantic long-legged mosquitoes, with long slender bodies, thread-like antennae, and a V-shaped groove on top of thorax. Some are 2 in. long while others are diminutive. Fly slowly and walk and fly rather awkwardly.

Found usually most abundantly among tall vegetation, in damp areas where there is relatively little wind, or not uncommonly in houses where they have been attracted by lights. Several thousand crane flies, of which at least 500 are American.

One species lays about 1,000 eggs in wet soil. These hatch in about 1 week into black worms or "leatherbacks" that develop in a few weeks into pupae; these live about 1 week before transforming into adults. Some larvae are found on land, some in rotten wood, some in plants, some in water or gravel. Some are 1 in. or more long.

Food of some adults, nectar; of others, nothing; of some larvae, animal matter; of others, plant tissue; and of others, decaying matter. Some larvae are nocturnal. Adults commonly dance in clouds, frequently swarming about lights.

Larvae of some species make excellent fish bait. Some destroy meadow plants and may injure pastures seriously; controlled by poison mash of 1 lb. of Paris green to 25 lb. of bran, with water.

Family Chironomidae

Punkies, No-see-ums
Culicoides gustipennis

Males with feathery antennae; under $\frac{1}{10}$ in. in length for the group and under $\frac{1}{20}$ in. for this species. Black with brown legs and with areas of white, yellow, black, and brown. Wings gray and brown, marked as indicated in figure.

6 of 20 known species in United States are biters of warm-blooded animals. Occurs in great flocks that settle down on man or cattle and begin biting viciously; unfortunately most abundant where scenery is commonly most beautiful, as in northern lakes and woods country.

Several hundred eggs laid in strings in water; hatch in 3-6 days into eel-like larvae that swim like snakes and feed on minute aquatic animals. Larva may live in ponds, pools, or even in a few drops of water in a stump. Pupa floats in vertical position in water for 3-6 days before transforming to adult stage.

One of most unpleasant pests to be found in normal vacation period of those who like to go to the wilds for a change. Usually come after black flies and mosquitoes have had their season. Fortunately, not known to be disease carriers.

Control is almost wholly through use of repellents (see House Mosquito, p. 421) and of nets and screens of such fine mesh that insects can be kept out. They go through ordinary mosquito netting with ease.

Midges
Chironomus sp.

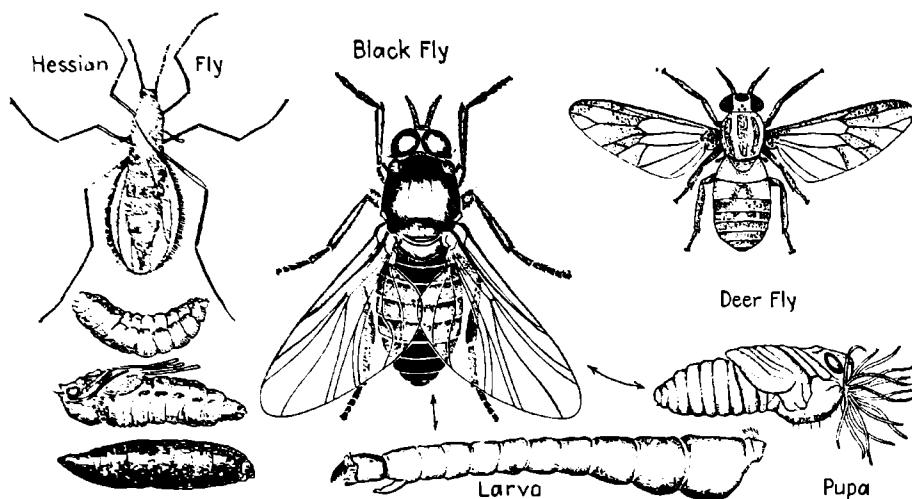
Adults like small mosquitoes but with more delicate abdomens, legs, and antennae. Wings generally lack scaly fringes on edges and veins that are characteristic of mosquitoes.

Commonly associated with water or vicinity of water, where they are seen dancing in great flocks. Over 200 kinds of midges in North America, some found in tidal pools as well as in fresh water.

One species lays a mass of about 700 brown eggs in water. These hatch in 3-4 days into larvae that require 1-2 months or more to reach pupal stage. Pupae swim like wrigglers near surface for a few days before transforming into adult stage.

Most midges are harmless but a few, like punkies of genus *Culicoides*, are most troublesome along streams and shores at certain times of year. Many midges may swarm at a time, giving a humming sound heard for some distance.

Aside from their role as pests (probably controlled like mosquitoes), vast majority of midges serve a most useful function in providing food for a great variety of young fish. In fact, they form major diet of some species important to man.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Diptera

Family Cecidomyiidae

Hessian Fly *Phytomyza destructor*

Length about $\frac{1}{10}$ in. Dark-colored, long-legged, rather large-winged for a gnat, and plumper than most. Since they are only about $\frac{1}{2}$ as long as a mosquito, they are not conspicuous. Most commonly recognized in flaxseed-like pupal stage.

Commonly found throughout Middle West and other parts of country. Now being established through most of United States and agricultural Canada. Introduced from Europe probably about 1779, when it was recognized on Long Island.

Eggs minute, laid in irregular rows of about $\frac{1}{2}$ dozen, each fly laying to 150 eggs on plant leaf; hatch in few days into pink or reddish maggots that eat way to stem joint, feeding about 1 month, killing plant above that point. Pupa flaxseed-like; this is the wintering stage in stubble. 1-4 generations a year.

Food of larvae, wheat, barley, rye, and some other grasses but never oats. A close relative, the wheat midge *Thecodiplosis mosellana*, introduced from Europe in 1819 near Quebec, attacks wheat, barley, rye, and oats. Only 1 generation a year. Hessian fly may destroy 50% of a wheat crop in bad years.

Probably, one of most injurious insect pests, doing millions of dollars of damage to wheat each year. Control is by encouraging numerous parasites, rotating crops to force egg laying elsewhere, destroying infected stubble by burning or plowing, planting so that plant cycle does not match insect cycle. Consult county agent or Experiment Station for latest information on control.

Family Simuliidae

Black Fly *Simulium* sp.

Adults small, short-bodied, hump-backed, short-legged; many black with broad iridescent naked wings. Males with eyes continuous, females with eyes widely separated. Some related species such as *Prosimulium hirtipes*, which appears late in season, have white on feet.

In season, adults are found in enormous numbers in wooded areas near streams, and are principal pest of Northeast in early summer. Buffalo gnat of Mississippi Valley, turkey gnat, and white-stocking black fly are others.

Mate in air in early summer. Female lays eggs on stones in rapid water. Eggs at first white or yellowish, then black. Larva remains attached to rock in swift stream, eating food brought to it by current, often forming black mats in swift water; finally builds small cocoon in which pupal stage of about 5 days is spent.

Food of most species, blood of mammals. A few species do not bite, but others make up for this. Frequently bites are not painful until later. Can locate food in night as well as in day and will feed almost any time during season.

Some are worst pests of territory in which they live. Most supply basic food for some species of fish. Some may be seriously annoying to cattle and other domestic animals as well as to man. Controlled by repellents (see House Mosquito, p. 421), screening, and spraying with DDT.

Family Tabanidae

Deer Fly *Chrysops vittatus*

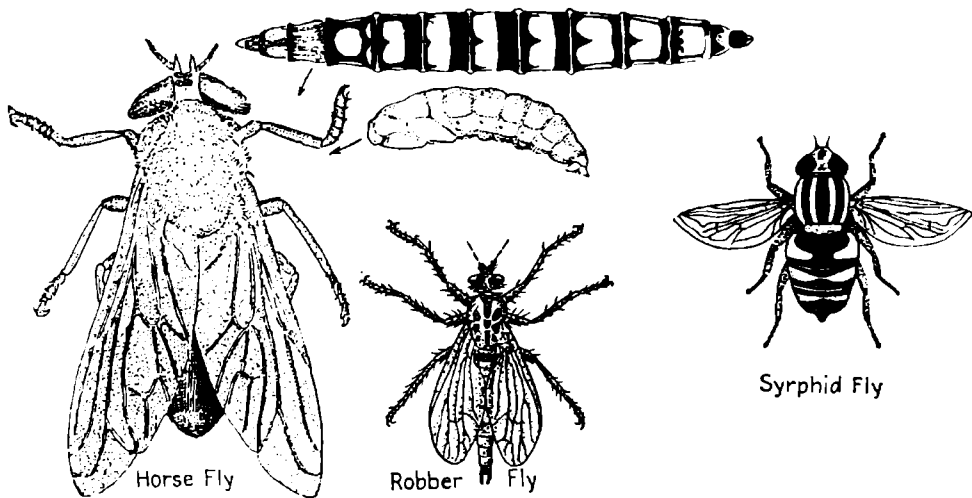
Length about $\frac{3}{4}$ in. General outline triangular. Eyes metallic, brightly golden, greenish, or coppery; wings with smoky bands; generally rather beautiful flies in every way except behavior. Marvelous fliers. Eyes of males touch each other, while those of females are slightly separated. At rest, wingspread to $\frac{1}{2}$ in.

Near woodlands or waterways during warm weather. At least 63 species of deer flies or ear flies, as they are known, in North America. Closely related to horseflies in same family. Commonly buzz around heads and ears of horses and man.

Glistening black eggs are laid on water plants, just above water line or on exposed stones at water's edge, forming conspicuous patches. Larvae worm-like, aquatic, drop into water, become $\frac{1}{2}$ in. long, feed on aquatic animals, and form pupae that are not enclosed in larval skin.

Food of larvae, minute aquatic animals; of adults, blood of man, horses, and some other mammals. Variety of hosts makes it possible for infected blood of one to be transferred to uninfected animal. Known to transmit blood parasite *Filaria diurna*, cause of filariasis, and *Bacterium tularense*, cause of tularemia.

Control is by draining possible breeding places. Abundance may greatly affect value of various areas for residential purposes. Ordinarily, little danger of infection from their bites, but they may be serious on occasion.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Diptera

Family Tabanidae

Horsefly

Tabanus atratus

Female, length to 1 in., black with blue-white bloom on back, wings smoky, eyes separated, outer wing margins not parallel. Male similar to female in general, but eyes touch each other and are proportionately much larger. Fast flier.

In woods or open, frequently annoying swimmers and cattle. Not gregarious as are some flies. Some 200 closely related species found in North America, including gadflies, green-headed monsters, and others.

Eggs laid on marsh plants, hatch in 1-2 weeks when exposed to sun. Larva, greenish-white "worm" which in some species may be 2 in. long, lives in water or in moist soil. Usually winters in soil and in spring forms yellow-brown pupa 1 1/4 in. long, adults emerging with advent of warm weather.

Food of larva and adult, other animals, adult female feeding on blood of warm-blooded animals. Bite is painful and is effected by a series of cutting and piercing stylets that can penetrate toughest hide. Known to play role in transmission of anthrax and lockjaw and the trypanosome that causes surra.

May be more important in spread of disease than is normally recognized. Certainly, while they may be beautiful to look at, they are not desirable companions at any time. Fortunately not abundant for any considerable portion of year and are confined to rather definite areas.

Family Asilidae

Robber Fly

Nasyllus notatus

Length of some species, 2 in., of others, 1/2 in. Wings usually, though not always, held at right angles to body. Eyes conspicuously large. Legs large. Abdomen slender. Some kinds resemble bumblebee rather closely. These are usually stouter and more hairy, but of course they have only 2 wings, like other Diptera.

Often found perched on an exposed stump or twig, eating prey or ready to pounce on it. Individuals are solitary. More than 500 kinds of robber flies known in North America. Family is one of largest in order Diptera.

Eggs usually laid on or under ground or in damp wood; hatch into legless worm-like larvae that feed upon other insects found in rotting wood, in loose soil, under or in leaves that are rotting, or under bark. Pupal stage usually spent in ground, without any special covering.

Food of larvae and of adults, other insects found in environment in which they live. Adults may be seen flying with a huge insect held firmly, or may be watched while finishing a meal. Robber flies relatively unsuspicious and always interesting to watch. Never attack man or domestic animals.

Economic importance varies since robber flies are not selective in insects they destroy and may kill useful as well as destructive species. Always worth watching.

Family Syrphidae

Syrphus Fly

Syrphus sp.

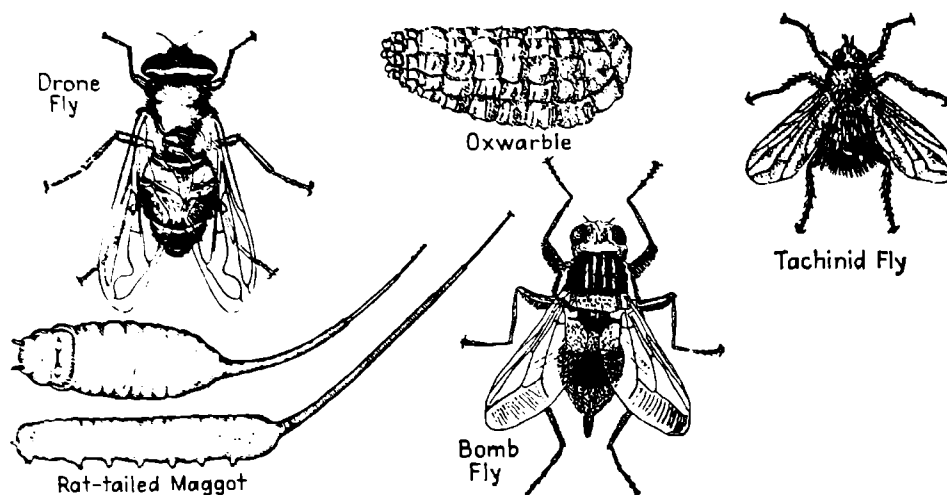
Prettily colored small flies, with yellow-banded or black abdomens; some resemble honeybees, while others are more like wasps, being bare and flying awkwardly like wasps. Most are excellent fliers and some give a droning or buzzing sound when in flight.

Found about fruits and flowers, particularly those with aphids on them, some hiding in flowers or feeding inside them. Some 300 kinds of syrphus flies in America north of Mexico, including rat-tailed maggots; closely related to drone flies.

Eggs of some species laid among plant lice; when eggs hatch, emerging larvae attack and kill aphids. Larvae slug-like, about 1/2 in. long, often with white stripes, commonly greenish, eyeless, flat, transversely wrinkled, and pointed in front.

Food of adults, usually pollen. 5 types of larvae represented in group, based on food: flat green type feeds on plant lice; cylindrical type bores into plant bulbs; those with long and short tubes feed in filth; short hemispherical type feeds on insects in ants' nests.

None of these insects stings man; however, larvae drunk in foul water may live in man, causing trouble; myiasis in man may be traced to syrphus flies. Most are useful destroyers of insects harmful to man's interests.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Diptera

Family Syrphidae

Drone Fly, Rat-tailed Maggot *Eristalis tenax*

Adults resemble honeybees, being yellow and black and about size of honeybees. Larva appropriately called "rat-tailed maggot," being provided with a long slender tube, which can be varied in length.

Found about dead carcasses, about privies, in foul areas generally, and probably responsible for belief, expressed by Ovid, Virgil, and Solomon, that bees originate from dead animals. Adults may enter houses in fall.

Eggs oblong, white, sticky, laid in groups of 20 or more, in crevices near foul water; hatch into larvae that live in cozes at bottom of quiet water, finally coming out to drier soil to form pupal stage that lasts for 8-10 days before adult finally emerges.

Food, decaying plant and animal matter. Tail lengthens or shortens, permitting larva to remain submerged in filth while it breathes relatively clean water above. This species was originally European but is now generally established.

Larvae may serve as food for some organisms and may act as scavengers, assisting in destruction of waste organic material. A 5-year old boy who drank from a filthy ditch suffered for 10 weeks because one of these larvae lived in his intestinal tract.

Family Oestridae

Bomb or Warble Fly *Hypoderma bovis*

Length about $\frac{1}{2}$ in. Body well covered with short hairy scales, relatively large. Abdomen with a dark band, bound in front with a broad light band and to rear with a narrower light band. Active flier and most annoying to cattle.

Found in sunny areas in summer. 2 species, both natives of Europe: *H. bovis*, common in Canada and the Northern States, and *H. lineatum*, more widely distributed. Rarely attacks cattle standing in shade of a tree or shed.

Eggs spindle-like, $\frac{1}{8}$ in. long, with a groove, laid singly, at base of cow's hair, in June-July; one female may lay 500 eggs. In 5-7 days larva hatches and enters host animal; in 4 months works way to throat, remaining there 3 months, $\frac{3}{4}$ in. long; makes sore or "warble," finally coming out to pupate 14-34 days in ground.

Larva eats its way through thickest hide, spoiling skin for sale purposes and of course interfering with host's health, growth, and production of milk. Some animals may be injured in trying to escape the fly, which often drives cattle frantic.

Control is by squeezing out grubs before they have time to pupate. Use a salve of 1 part iodoform to 5 parts of vaseline. Infection may be checked by removing eggs from hairs before they hatch.

Family Tachinidae

Tachina Fly *Bombyliopsis abrupta*

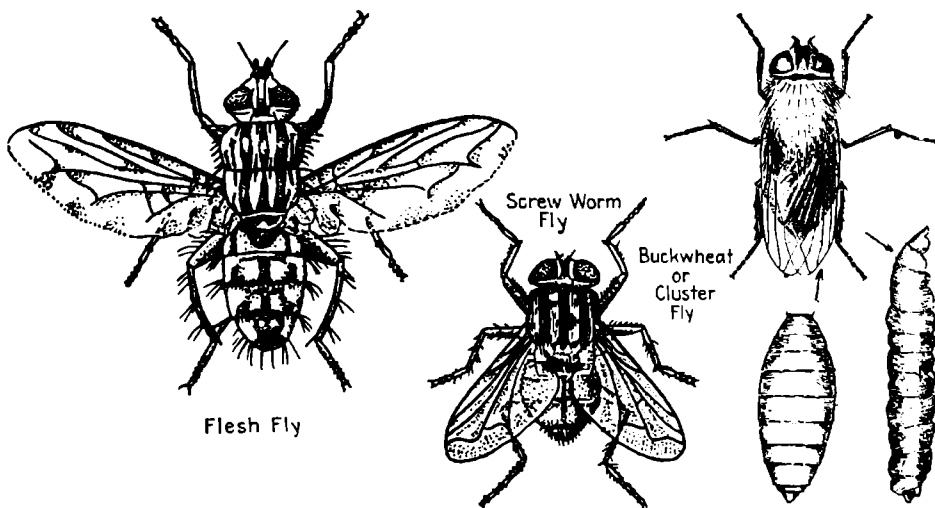
Vary greatly in size, some being $\frac{1}{2}$ in. or more long while others are diminutive. Usually short, stout, covered with stiff hairs, and in general, shaped like a housefly, with which some might be easily confused except for stouter abdomen and numerous noticeable stiff bristles.

Adult found usually among vegetation where prospective victims may be abundant, on flowers, leaves, stems, or other parts. Some 1,400 species of tachinid flies known from North America alone, including some of most useful of all insects.

Eggs or, in some cases, living larvae are laid on bodies of caterpillars and other insects, sometimes in great numbers. Maggots bore into host, feeding on its tissue and finally killing it. Then maggots emerge, pupate, and finally develop into adults that mate and repeat cycle.

Food of larvae, bodies of insects in which they find themselves, methods of entering host being many. In some, host eats egg; in others, as in *Eupelsteria* that attacks brown-tail moth caterpillar, maggot rests on thread that caterpillar follows to its nest.

Many investigators who have had little success in getting moths to emerge from cocoons have failed because of activity of these flies. Without them many agricultural practices would be infinitely more difficult.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Diptera

Family Sarcophagidae

Family Calliphoridae

Flesh Fly

Sarcophaga sp.

Sarcophaga haemorrhoidalis, just over $\frac{1}{2}$ in. long. Gray with darker spots making a somewhat checkerboard-like design on top of abdomen; series of about 5 discontinuous streaks on upper part of thorax. Hairy scales sparingly present on body. Some species silvery or changeable in color. Eyes not hairy.

Found in a variety of situations, but not so common in houses as are houseflies. Many are seen laying their eggs on flesh, carrion, dung, other insects, and other kinds of organic material. Family is large with wide distribution and considerable economic importance.

Probably all these flies deposit living larvae, rather than eggs, on substances that larvae eat. As many as 20,000 eggs have been found in a single female, indicating tremendous reproductive rate. Pupation may take place after larva has left its source of food supply.

Food of larvae and adults, usually filth. In addition to those suggested above, food supplies include rotting vegetable material, stomachs of human beings, wounds in human beings, stomachs of frogs, skin of turtles, living snails, and eyelids of humans.

Fundamentally, these flies are scavengers suited for destroying decaying organic material. They deposit filth, they eat anywhere, and have been known to cause intestinal and skin myiasis in man and to aggravate wounds and tumors that were in process of healing.

Screwworm Fly

Cochliomyia americana

Length to $\frac{3}{2}$ in., though some are only $\frac{1}{4}$ in. long. Slate-black, with 3 distinct darker longitudinal stripes on thorax. Abdomen glistens like metal. Eyes rusty brown. In general appearance, resembles a large metallic housefly.

Widely distributed, but most common in South and Southwest. Abundance spotty in North and East, species being absent in some states. Adults fly about sores, wounds, or any parts of animal from which foul odors or discharges may come, including the nose, ears, mouth, and eyes.

Eggs most commonly laid in nostrils of domestic animals, but any wound or decaying matter will suffice. Larvae hatch in a few hours or days and burrow into tissue, mature in 4-5 days in living animal or longer in dead animal, drop to ground and pupate. Pupal stage lasts from 3 days to 2 weeks and cycle can be completed in from 1-4 weeks.

Food essentially flesh, living or dead. Favored points of attack include, in addition to those suggested above, navels of newborn calves, branding sores, and cuts by barbed wire. In some cases larvae make their way to cavities of head, causing death. Larvae about $\frac{3}{4}$ in. long, with bristles making a screw effect.

Infection by these flies may be fatal. A potent source of myiasis. Persons sleeping in open may receive infections through nose, for which surgical treatment may be necessary. Douches of chloroform in milk, 10%, have been used for nose treatment.

Cluster or Buckwheat Fly

Pollenia rudis

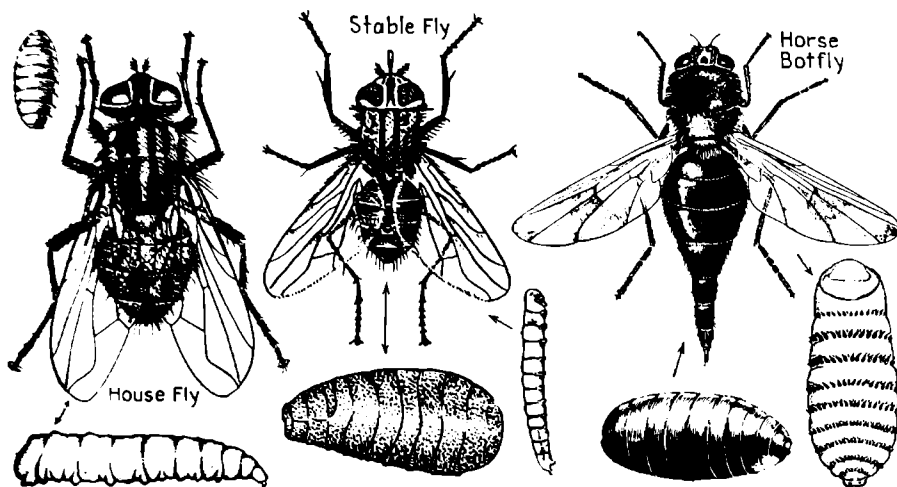
Slightly larger than a housefly, but much more slowly moving and with wings held more closely together; behaves sluggishly; thorax dark-colored; woolly with hairs. Abdomen brown with pale spots; space between eyes, white. Greasy when mashed, and with disagreeable odor.

Found most commonly on windows in fall, and in spring when they are trying to get out, at which times they may cluster together as their name suggests. Introduced from Europe at an early and unknown date. Sometimes found on snow, on soil, or on the outside walls of buildings in sun.

Adults mate about February. Eggs laid on garden soil a month later, as many as 97 in an evening; hatch in 4-6 days into white legless maggots that live in earthworms as parasites about 3 weeks. Pupate in soil for 2-6 weeks and winter as adults. Found in large numbers as adults only when seeking or leaving hibernation.

Food of larvae, earthworms; of 107 earthworms examined, 74 supported total of 87 cluster fly maggots. Above temperature of 50°F., adults go toward light and avoid contacts; below that temperature they avoid light and push against contact. This explains much of their behavior.

May be annoying to housekeepers; are enemies of earthworms; serve as food for many insect eaters. Closely related to bluebottle flies and screwworm flies.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Diptera. Family Muscidae

Housefly

Musca domestica

Length about $\frac{3}{4}$ in. Body blackish. Eyes reddish-brown. Wings transparent. Mouth suited for sucking. Male with eyes nearer together than in female; abdomen with sides brownish rather than gray all over. Active and almost too well known to need description.

Found almost everywhere that man exists, being most abundant in summer or warmer months and in regions where manure or decaying plant or animal matter is to be found.

Female lays to 600 eggs, in clusters up to 125 at a time, preferably in horse manure exposed to sunlight, from early summer through to frost. Eggs hatch in 8-12 hours in warm weather, or to 3 days when cool. Larva, whitish maggot that reaches full development in about 5 days. Pupa in old larval skin, either where larva developed or elsewhere; about 5 days duration.

Food of larva, almost any decaying plant or animal matter. Adult transfers filth freely from place to place by emptying stomach for new meal. Since adults do not lay eggs until about 2 weeks after emerging, a life cycle is about 24 days. May be 10 generations a year.

One female in April might have $5\frac{1}{2}$ trillion descendants by September. Known to carry typhoid, probably diarrhea, dysentery, cholera, and possibly tuberculosis. Control is by screening, use of traps, and destruction of breeding places, as well as consistent swatting programs and DDT.

Biting Housefly or Stable Fly

Stomoxys calcitrans

Length $\frac{1}{4}$ - $\frac{1}{2}$ in. Gray with darker mottlings. Eyes reddish, and those of male separated by a distance $\frac{1}{4}$ diameter of head, while those of female are separated by $\frac{1}{3}$ that measurement. Legs black. Wings relatively clear. Mouth distinctly suited for piercing instead of for lapping, as in housefly.

Common almost anywhere outdoors in warm weather, or indoors when weather is muggy. Widely distributed over the world and recognized by most as biting housefly, although it is not a housefly. Reported that these flies captured near woodlands have brownish wings.

Eggs about $\frac{1}{25}$ in. long, placed on any moist substance, have a distinct lateral furrow, hatch in 1-3 days. Larvae much like those of housefly, living on a great variety of decaying substances, even decaying lawn grass; mature in 11-30 or more days. Pupate in old larval skin, 6-20 or more days. Life cycle, 19 days to 3 months or even more.

Food of larvae, decaying organic material but favor decaying straw in manure. Probably winter is passed in larval or pupal stage, as is believed to be case with housefly. Reputed without too much proof to be involved in spread of infantile paralysis and some other diseases.

A most annoying fly on warm humid days. Control is like that of housefly, centered on screening, on traps, and on destruction of breeding places. Quicklime spread on wastes is probably most effective way to get rid of breeding areas; spraying resting spots with DDT is also effective.

Horse Botfly

Gastrophilus intestinalis

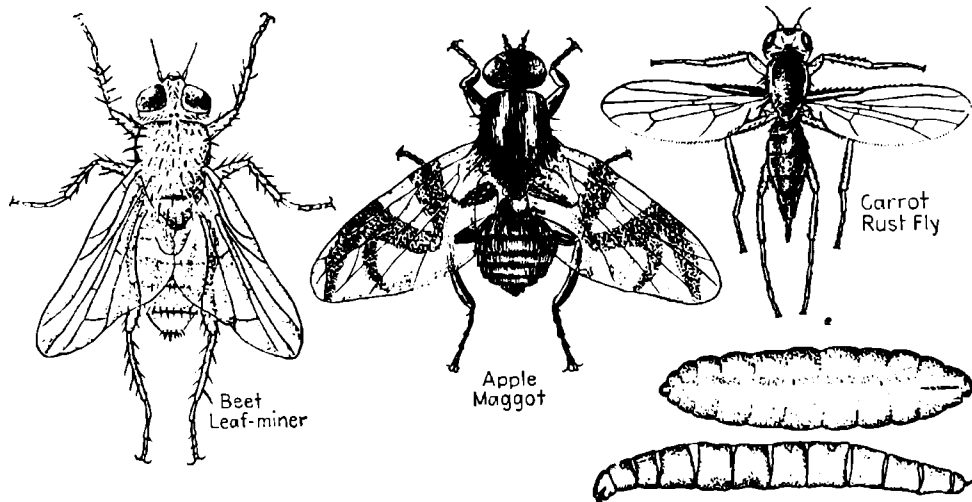
Length about $\frac{3}{4}$ in. In general, resembles honeybee, but female has a long abdomen bent back under body. Wings with dark spots, those in center forming an irregular crossband; otherwise wings are transparent.

Seen commonly buzzing about heads of horses, donkeys, or mules, causing animals great excitement. Found practically everywhere in world where horses and their kin are found. Close relatives include the nose fly, with its red tail, and smaller chin or throat fly.

Female may lay to 500 yellowish eggs, usually on hair on foreknees of horses. These are licked off and hatch when moist and pressed. Larvae find way into horse's stomach, where they live 8-10 months, molting twice, and sapping vitality of horse, as they are attached to stomach lining. When mature, they pass out in manure, enter ground, pupate 30-45 days.

Food taken from host animal, anywhere from stomach through intestines to rectum, often causing severe irritation and sometimes serious illness. Other closely related species live somewhat similarly in deer, squirrels, rabbits, and other mammals.

Control essentially by spraying regions where eggs may be laid, namely, forelegs of horse, with a mixture of offensive pine tar and lard or with DDT, and use of medicines to force larvae from intestinal tract.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Diptera

Family Anthomyiidae

Beet Leaf Miner

Pegomya vicina

Length about $\frac{1}{4}$ in. General color gray. Sparsely covered with rather long stiff black hairs. Body commonly held in a curved position. Presence of species is most easily recognized by blotch it mines in leaves of beets and spinach.

Very common in regions where sugar-beets, spinach, and chard are raised, and widely distributed through world. Leaf mines may be either blotches or twisting paths.

Eggs white, placed by female on lower surface of leaf, in masses of 2-5, hatch in 3-4 days; white to transparent maggots enter leaf and make mine between upper and lower surfaces. Larval stage lasts 7-9 days and is followed by pupal stage, which lasts 10-20 days, either in leaf or on ground.

Maggots may injure marketability of leaf crops and production of root crops. Since maggots live on inside of leaves, they are not affected by usual insecticides, which ordinarily reach only surface of leaves.

Control is by picking infected leaves in small gardens and destroying them, to prevent multiplication of pest. Deep plowing and thorough harrowing at end of year may destroy resting insects in soil. Spinach is sometimes planted as a trap crop in sugar-beet fields, since flies seem to favor spinach. Consult county agent or Experiment Station for latest controls recommended.

Family Tryptetidae

Apple Maggot

Rhagoletis pomonella

Length about $\frac{1}{4}$ in., wing span under $\frac{1}{2}$ in. At rest, fly appears like an equilateral triangle; wings with 4 connected dark crossbands. Abdomen dark, with 4 light narrow bands across rear portion.

A native fly, most abundant and troublesome in eastern United States and Canada where apples may be an important crop. Adults are found from July-September. Family is large and includes many gall makers; most adults have marked wings.

Female has sharp ovipositor with which she places to 400 eggs under skin of apples. Eggs hatch in 2-6 days. White, $\frac{1}{4}$ -in. maggots develop for 2 weeks to reach maturity, then leave apple to form pupae that look like leathery grains of wheat. Pupa usually underground for winter.

Food of larvae, pulp of apple, which of course is ruined for market. Wound causes brown areas to form on skin of apple. Adults feed on fruit juices without themselves causing much direct injury.

Control commonly by spraying with 2 gal. of cheap molasses and 6 lb. of lead arsenate to 100 gal. of water in early July, since flies do not lay until 4 weeks after they emerge from pupal stage. Consult county agent or Experiment Station for latest information on control.

Family Psilidae

Carrot Rust Fly

Psila rosae

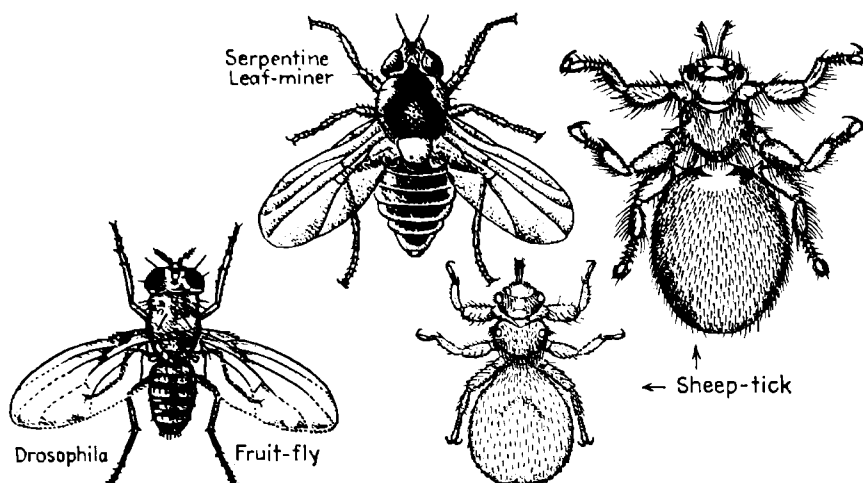
Length about $\frac{1}{8}$ - $\frac{1}{4}$ in.; wing span $\frac{3}{8}$ in. Dark-green to black, sparingly covered with yellow hairs. Head and legs pale yellow. Eyes black. Presence is most conspicuously indicated by rusty injury to crops it attacks. Found May-September as adults.

Common in fields and rather widely established. Originally came from Europe where it was a serious pest in Germany and England. Appeared in Canada in 1885, in New York in 1901, and has since spread rather widely.

Eggs long, white, about $\frac{1}{50}$ in. long, laid on base of plant or in soil in May or in fall; hatch in about 1 week. Larva a tiny straw-colored maggot, $\frac{1}{8}$ in. long, which leaves a telltale rust-colored burrow behind it. Larva eats way through leaves and roots and pupa is formed in soil. 1-2 generations a year.

Food of larva, leaves and roots of carrots, celery, parsnips, and similar plants. It eats the heart of celery, ruining the plant for market purposes. Borings in root crops cannot be concealed easily and affect market value.

Control largely by rotating crops so that food species will not be available year after year to continue numbers. Emulsion of 1 part of kerosene to 10 of water sprinkled along rows of young carrots has had some effect in keeping numbers down. Consult county agent or Experiment Station for latest information on control.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Diptera

Family Drosophilidae

Fruit Fly

Drosophila melanogaster

Length about $\frac{3}{16}$ in. Wing span about $\frac{3}{8}$ in. Male slightly smaller than female and with hind part of abdomen more strongly colored; male also has "sex combs" on front legs, though their function is not known.

Found about fruit or decaying plant tissue in great numbers and widely distributed. They are called pomace flies, sour flies, and vinegar flies, names that associate them with spoiling fruit juices.

At room temperatures, eggs are laid on such fruits as grapes or bananas or on vinegar or beer; hatch in 2 days. Larvae are diminutive maggots that mature in 3-4 days and develop into small oval pupae which last 4-5 days in fruit. Under ideal conditions, complete life cycle may be passed in 8 days.

Food suggested by notes above. Essential role of insect is that of scavenger. Strongly sensitive to light and will fly toward it from a darkened chamber. Reproductive powers enormous; in a few weeks of suitable weather numbers may become tremendous.

Major use to man is in study of heredity. Their superficial characters and variations are transmitted readily to succeeding generations, and study of many generations is possible in a relatively short time.

Family Agromyzidae

Serpentine Leaf Miner

Agromyza pusilla

Diminutive flies with large heads; wings about equal to length from tip of head to tip of abdomen. Body sparingly hairy. Abdomen with light markings in bands between segments. Presence most easily indicated by worm-like boring in leaves, though blotch mines also may be made.

Mines of this species found in 55 different kinds of plants. Probably most widely distributed and commonest of approximately 100 North American species known in this family, not including Mexican species. Group is closely related to botflies.

Female inserts eggs under skin of leaves. Maggots eat winding or blotch burrows within leaf, mines constantly growing wider. Full-grown maggot retreats from end of burrow about $\frac{1}{4}$ in., cuts a slit in leaf, drops to ground and forms pupa, or pupa may be formed in leaf itself.

Adults lay eggs in early spring, may rest through winter, though in some cases there are a number of generations a year. Maggots shed skin twice in mine. Rarely more than one mine to a leaf. Some closely related species make plant galls. In South may remain active year round.

Not a serious pest to plants in which larvae live. Control is not easy because larvae are protected within leaves. Picking infected leaves may be worth while if plants need to be perfect for market purposes.

Family Hippoboscidae

Sheep Tick

Melophagus ovinus

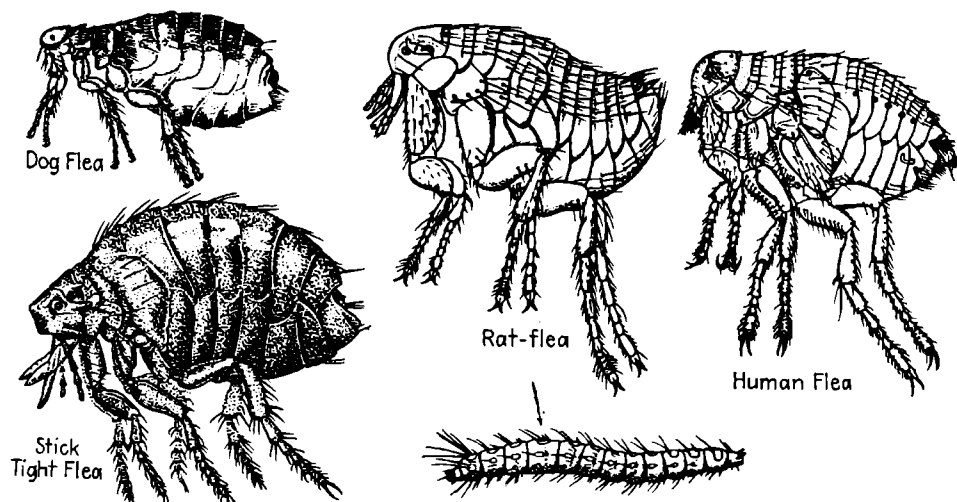
Length about $\frac{1}{4}$ in. Wingless, with 6 conspicuous legs and an enlarged abdomen that bears 4 dark spots joined in 2's on back. Reddish or gray. Whole body covered with long bristly hair-like scales. A true fly.

Found commonly on sheep wherever they are raised. Not related to cattle ticks, which are related to spiders. Other "ticks" that are actually flies are bat ticks that live on bats and bee lice parasitic on honeybees. However, these belong to different families.

Female does not lay eggs but retains them in her body and nourishes them until they hatch into larvae. When larva is nearly completely developed, it is placed on sheep, covered with a white membrane that soon becomes brown and hard. Within this, pupa is formed. Adult emerges in 19-24 days. 10-14 days later, this adult may produce young.

Female may produce a larva every 12-15 days and in lifetime may produce 12-15. Adult lives in fleece of sheep except when it is feeding. It then moves to skin, pierces it, and sucks blood and lymph. Irritation caused by many feeding ticks may cause sheep to lose weight.

Control is commonly effected by dipping in mixtures containing coal tar, creosote, lime-sulfur, arsenic, or cresol. 2 dippings are usually necessary, about 1 day apart. Sheep sheared in spring are ordinarily dipped in July and August. Consult county agent or Experiment Station for latest control measures.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Siphonaptera

Insects of this order have strongly compressed bodies and are without wings or compound eyes. They have well-developed legs and mouths suited for sucking. Over 1,000 kinds of fleas recognized, some of which are of great importance. They are divided into 5 families, of which the Pulicidae and the Echidnophagidae are the more important. In latter family, the chigoe or jigger, *Tunga penetrans* (not the chigger), is tropical and forms sores under nails of people who go barefoot in infected sand; sticktight flea, *Echidnophaga gallinacea*, is a serious pest of poultry in Southwest.

Family Pulicidae

Dog Flea *Ctenocephalus canis*

Length about $\frac{1}{10}$ in. Members of this genus have a shoulder-cape (pronotal) comb directed backward and also a comb-like "mustache," which are lacking in other species discussed here.

9 species in genus, most of which are found on flesh-eating animals. Dog flea attacks man about as readily as it does dogs and is very common in the Middle Atlantic States. Cat flea has larger head than dog flea. Both were originally European.

Female lays 70 or more waxy white eggs on dog or floor. These hatch in 10-16 days. Larva active, worm-like, living 10-14 days in cracks and crevices before forming pupa in a fine cocoon that remains dust-covered for 7-10 days before producing adult.

A generation from egg to adult may be passed in from 14-37 days. These fleas may jump 7 in. high and over 1 ft. on horizontal. This species is known to carry dog tapeworm from dog to dog. Strongly suspected of carrying bubonic plague and other diseases of man.

Asiatic Rat Flea *Xenopsylla cheopis*

Length about $\frac{1}{10}$ in. Differs from human flea in that it has a divided mesosternum. See Ewing's "Manual of External Parasites" for details regarding classification of all fleas, and Waterston's British Museum bulletin on "Fleas" for economic notes.

Some 30 species of this genus in world, of which only 2 are known in America. This species probably originated in Nile Valley in Africa and has spread largely as a parasite of its normal rat hosts. This is a most effective transmitter of plague.

Egg: in India, 2 days; on West Coast of United States, 9-13 days. Larva: in India, 1 week; on West Coast, 32-34 days. Pupa: in India, 7-14 days; on West Coast, 25-30 days. Complete generation: in India, 21-22 days; on west coast, 9-11 weeks.

Bubonic plague carried by bite of this flea, the disease organisms being rubbed into bite; fleas leave infected rats when they die and go to human host. This flea has been responsible for tremendous loss of human life, some in America. It also carries nonepidemic typhus fever.

Human Flea *Pulex irritans*

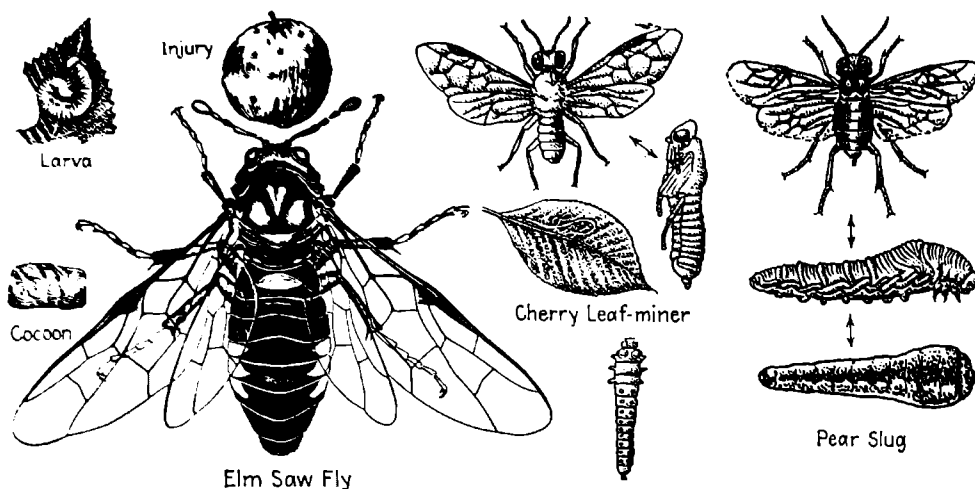
Length about $\frac{1}{10}$ in. Differs technically from Asiatic rat flea in that it has an undivided mesosternum. Rear of abdomen of male turns upward, of female downward.

Common, particularly in Europe; also known from Africa and Asia; reported from South America. Rather restricted in distribution in North America, being most common in California and sparingly common in Mississippi Valley. 2 species in genus.

Egg: East Coast, 2-4 days; West Coast, 7-9 days. Larva: East Coast, 8-24 days; West Coast, 28-32 days. Pupa: East Coast, 5-7 days; West Coast, 30-34 days. Full generation: East Coast, 2-4 weeks; West Coast, 9-11 weeks. In Australia and Europe, a complete generation requires 4-6 weeks. Lays to 500 eggs. Can live unfed 4 months; fed at intervals, 18 months.

Strange to say, it is difficult to rear fleas under artificial conditions. Can jump 7 in. vertically and 13 in. on horizontal, on the average. Human fleas bite rats and can carry bubonic plague, after 3-day infection.

Fleas are controlled largely by preventing multiplication by killing their nonhuman hosts such as rats, by fumigating infected houses, by isolating sick persons who might infect fleas and continue the cycle. Mice also must be destroyed. Cats and dogs should be washed with insecticides and their beds changed and washed. Cats and dogs should have definite sleeping and resting places that can be kept clean. Good disinfectants include 3% creolin, carbolic soap, powdered naphthalene, kerosene, pyrethrum powder. DDT is effective if sprayed onto floors or beds used by pets. Pupae cannot survive sudden jars, so beating of infected bedding and rugs is effective.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Hymenoptera

In insects of this order, adults usually have 4 membranous wings with few or no cross veins, rear wings smaller. Mouth parts suitable for chewing, sucking, or both. Females usually with a sting or ovipositor. Metamorphosis complete.

Family Cimbicidae

Elm Sawfly *Cimbex americanus*

Length of adult female, $\frac{3}{4}$ in. Female, head black, abdomen steel-blue or purple with 4 yellow spots on each side, wings smoky-brown, legs black, antennae short and pale yellow. Male, longer, more slender, and with some color variation. Number of color varieties. Adult May-June.

Common on woody plants but most common on elm, willow, poplar, and basswood in Middle West. Family is small and its members are closely related to hornails and typical sawflies.

Eggs laid in pockets in leaves, hatch into yellow-white larvae which reach maturity in July-August. Mature larva with black lines down middle of back, descends host tree, burrows into ground, and spins an oval brown cocoon in which winter is spent. In spring larva changes into pupa from which adult emerges in May-June.

Food of larva (which chews), leaves of birch, willow, elm, basswood, poplar, and some other trees. Plants attacked appear as if struck by fire and may even be stripped of leaves. Larva holds to plant by grasping with end of body, and may squirt a defensive acid liquid from lateral glands.

Control is by use of stomach poison such as is provided by a lead arsenate spray or DDT.

Family Tenthredinidae

Cherry Sawfly Leaf Miner *Profenusa collaris*

Adult about $\frac{1}{2}$ in. long. Female metallic black on body, reddish on fore parts. Male smaller, with lighter colored, more slender abdomen than female. Appears as adult in May.

Probably native, living originally mostly on hawthorn, but now living equally well on cherry leaves, where it appears as a leaf miner. In New York and Massachusetts, it may occasionally reach pest abundance.

Eggs laid singly, in slits in upper leaf surface, usually in basal part of leaf; hatch in mid or late May. Larva makes twisted mine in leaf, molts 5 times, leaving skins in blister-like mines; 6 legs, with additional prolegs. Larva leaves mine, enters earth in June and makes waterproof cell but does not pupate until following spring, so winter is spent as larva. Pupa in cocoon several inches underground, under $\frac{1}{2}$ in. long, white, about 1 week. Adults appear in early May, following pupation.

Food, leaves of cherry and hawthorn.

Control chiefly by picking and destroying mine-bearing leaves. A nicotine spray commonly used to control pest on hawthorn does not seem to be effective on cherry. Consult county agent or Experiment Station for latest information on control.

Pear Slug *Eriocampoides limacina*

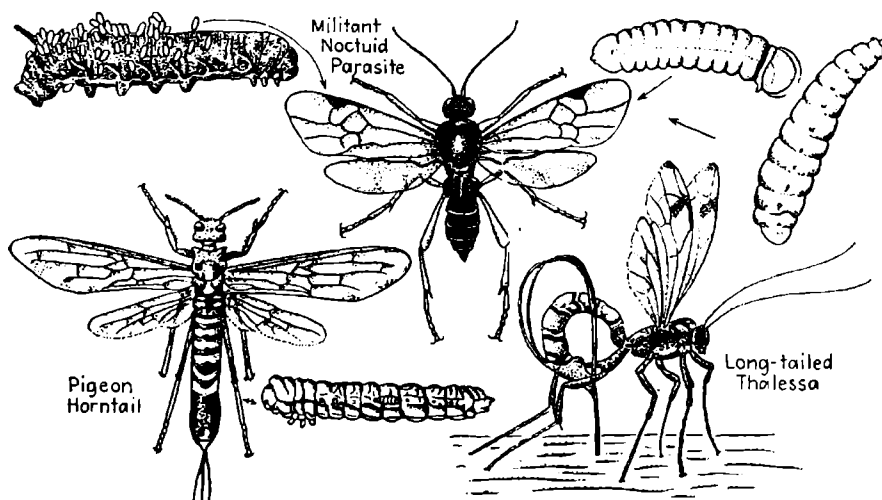
Adult $\frac{1}{2}$ in. long. Body black, bluntly pointed to rear. Wings relatively large, longer than body and head. Adult appears after leaves develop in spring. Species conspicuous because of glossy dark slime produced by larva.

Native of Europe but now found in America nearly everywhere that pears, plums, or cherries are grown.

Eggs laid in slits in developing leaves, forming blisters. Larva produces brown glossy concealing slime and hence looks somewhat like a slug; molts 4 times, after which it is orange-yellow and does not feed. Larva goes to ground to pupate. Winters as pupa, but in South may be 3 generations a year.

Destroys leaves of pear, cherry, and plum, causing leaves to turn brown because upper leaf surface is removed. Trees badly infested may lose all leaves by midsummer.

Control by spraying with standard arsenate of lead; 40% nicotine sulfate, 1 pt. in 100 gal. of water with 3-4 lb. of soap; 1 qz. of white hellebore in 3 gal. of water; or by dusting with freshly slaked lime. Consult county agent or Experiment Station for latest recommendations on control.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Hymenoptera

Family Siricidae

Pigeon Horntail *Tremex columba*

Length about 2 in. Abdomen more than half length of body and almost cylindrical, ending in a stiff "tail" about $\frac{1}{3}$ length of abdomen. Wings relatively short for an insect of this size. Color usually yellow, with reddish-black or brown markings, depending on locality.

Abdomen black with yellow bands and spots, northeastern United States, Quebec, and Ontario; yellow with black markings, Rocky Mountains and Pacific Coast; yellow with dark-brown wings, Pennsylvania to Utah. Usually found on dead hardwood trees.

Female in summer bores into wood with ovipositor to depth of $\frac{1}{2}$ in. to lay eggs singly; frequently dies stuck in wood when last egg is laid. Larva cylindrical, with 3 pairs of legs near head and a horn near rear; to $1\frac{1}{4}$ in. long; digs a burrow about diameter of a pencil. Pupa in silk cocoon, in chip-lined burrow from which adult emerges in early summer.

Food of larva, wood of apple, beech, elm, maple, oak, pear, sycamore, and other hardwood trees. Sometimes found in firewood in buildings, or in furniture where wood has not been thoroughly cured.

Destructive to wood of valuable species of trees. Infected wood should be burned before other larvae have a chance to transform. Long-tailed ichneumon is chief enemy.

Family Braconidae

Militant Noctuid Parasite *Apanteles militaris*

Adult about $\frac{1}{6}$ in. long, black with yellowish legs and distinct black spot on front margin of forewings. Abdomen small, considering its egg-carrying capacity. More commonly seen in form of cocoons extending from body of parasitized caterpillars than as adults.

Widely distributed in United States and Canada, generally present wherever its caterpillar hosts are to be found. Adults active in egg laying mostly on warm sunny days.

Female may lay 1,000 eggs, putting as many as 72 in single puncture in caterpillar that has not yet reached last larval stage. Eggs $\frac{1}{300}$ in. long, white; hatch in 5 days into larvae that feed on inside of caterpillar about 9 days, eating less essential tissue first, then pierce skin of caterpillar and form cocoons $\frac{1}{4}$ in. long and dirty white or brown in color; adults emerge in 9 days and live 1 week or more.

Food of adults, nectar or honeydew; of larvae, caterpillars of noctuids, such as army worm, corn-ear worm, or their close relatives. Females may mate or may lay eggs without mating; unfertilized eggs produce males. May be 2 generations a year. Winter as larvae in North and as pupae in cocoons in South.

Exceptionally useful in control of caterpillars that destroy many plants useful to man.

Family Ichneumonidae

Long-tailed Ichneumon *Megarhyssa lunator* and *M. atrata*

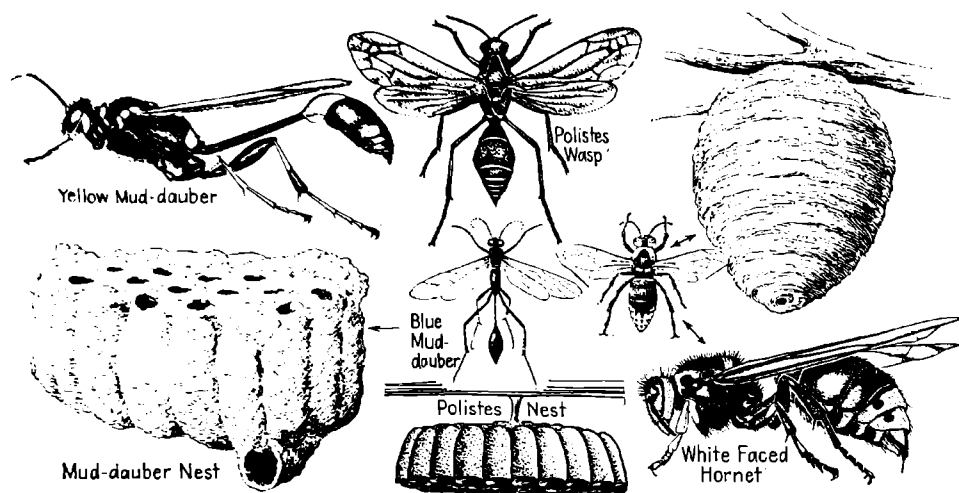
Female, length (exclusive of "tail") $1\frac{3}{4}$ in.; including "tail," about 6 in. *M. atrata* black with a few yellow spots; *M. lunator* brown with yellow spots. Ichneumon flies vary from this large size to almost microscopic forms parasitic on plant lice. Related wasps parasitize insect eggs.

Relatively common in summer on trees infested with horntails, which they parasitize; larvae in tunnels of horntail larvae.

Female searches tree trunks for horntail tunnel. Finding one, she works her long slender ovipositor into bark and wood to tunnel and lays her egg. Larva seeks out horntail larva, attaches itself to it, and feeds until full-grown; pupates in tunnel and gnaws way to freedom when adult.

Food, larvae of horntails. Interestingly enough, ichneumons are themselves parasitized by another hymenopteran, a cynipid. We have, then, one hymenopteran, the horntail, parasitized by the hymenopteran ichneumon, which is parasitized in turn by still another hymenopteran, a cynipid.

Unquestionably useful as a control of the horntail so destructive to wood of valuable species of trees.



PHYLUM ARTHROPODA. CLASS INSECTA

Order Hymenoptera

Family Sphecidae

Mud-dauber Wasp

Sceliphron coementarium

Yellow mud dauber, *S. coementarium*, (illustrated) has black and brown body, with yellow spots and yellow on legs. It is about 1 in. long, slender-waisted and brown-winged. Blue mud dauber, *Cedobion californicum*, is steel-blue throughout and usually smaller than yellow wasp.

Both blue and yellow mud daubers are general in their distribution; build under eaves, in houses, barns, and sheds, under bridges, or wherever their mud nests may be free from too much water, and where spiders are abundant near by.

Female builds mud cup enclosing series of tubular cells, each about 1 in. deep and $\frac{1}{4}$ in. through. Series may enclose 1 to many cells, and many series may be crowded together. Egg placed in a cell and several paralyzed spiders sealed within cell with it. Larva feeds on paralyzed spiders; pupa formed in cell. Pupa of blue wasp, silk-covered; of yellow, uncovered.

Food of adults, nectar; of larva, paralyzed spiders. Blue mud dauber may sometimes despoil nest of yellow, throw out yellow grub, and deposit her own egg.

Relatively harmless but tremendously interesting wasp whose status in the biological cycle is complicated. Since it eats spiders that control plant-destroying insects, logically it is not useful to man.

Paper Wasp

Polistes sp.

Length 1 in. or over. Long slender dark brown to black, with red spots on abdomen and one or more yellow rings. Female with brown face. Male with pale face and longer antennae.

Common on flowers and about buildings; constructs open-comb paper nests wherever protection from rain is assured. 4 highly variable species of paper wasps in United States and about 50 in world. Closely related to hornets.

Female lives through winter. In spring she builds paper nest in sheltered spot, with cells opening downward and uncovered beneath. In these eggs are placed and young reared. Grubs hang head downward in cells, are fed nectar and insects. Pupal stage in silken cocoons spun by larva in cells of nest. Mating occurs in fall, then males die.

Not vicious unless annoyed; sometimes may be handled with perfect safety. Food not ordinarily stored, since young are fed as need occurs and mother hibernates. Females alone care for young. Nest of paper supported by single stem, contains single layer of unprotected cells; waterproofed by new material licked on by female.

Perhaps of some economic importance as destroyers of other insects. Common in houses in fall and winter, before and after hibernating period; feared more than is justified. Author has lived for 25 years with polistes nest within few feet of his bedroom window, has handled the wasps and never yet been stung by one.

Family Vespidae

White-faced Hornet

Vespa maculata

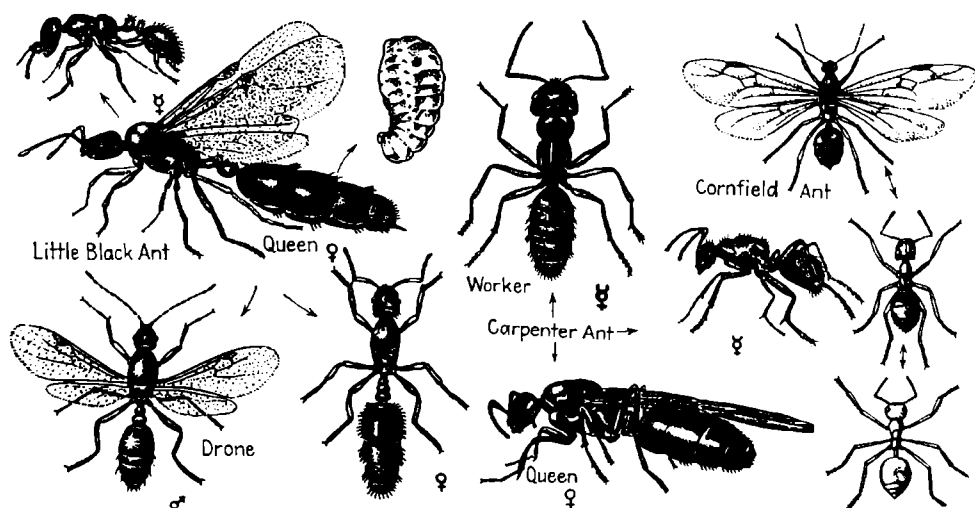
Length of queens, over 1 in.; of workers, about 1 in.; males (drones), intermediate in size. Black with white markings on body and face, antennae rusty beneath. At rest, wings are held folded lengthwise over back. Queens seen most commonly early in season, workers in midsummer and fall, drones in fall.

Found in various places but most conspicuous about their large paper nests or as they feed about flowers. Vicious about nests, but away they normally do not attack unless confined or restrained. They and related yellow jackets may make nest size of bushel basket, housing 15,000 insects.

Eggs laid by queens in paper nest; develop in about 1 month. Egg stage 5-8 days, larva 9-12 days, pupa 10-13 days. First produced are workers, then drones, then new queens. All but drones hatch from fertilized eggs. All but females die in winter. Mate once soon after males emerge.

Food of adults, nectar and insects, chiefly latter. Elaborate nest of paper encloses many layers of cells opening downward. Queens start nest and rear first workers, but later leave such tasks to workers and devote themselves to laying eggs. Nest kept clean first by queens, then by workers.

Of some use as destroyers of other insects. Sometimes pests about apiaries, where they kill honey-laden bees. Also may cause panic among horses. Stings may be severe to persons disturbing nests. Attack sudden and most effective. Ammonia on stung spots may help relieve pain. Nest may be burned at night, when whole colony is inside.



PHYLLUM ARTHROPODA. CLASS INSECTA
Order Hymenoptera. Family Formicidae

Little Black Ant
Monomorium minimum

Length about $\frac{1}{16}$ in. for wingless workers, $\frac{1}{4}$ in. for queen, $\frac{3}{16}$ in. for male. Black. Queen with wings that are shed after mating, as in all ants; unusually large abdomen. Male winged. Larva $\frac{1}{16}$ in. Pupa $\frac{1}{8}$ in. Waists of queen, drone, and worker constricted as by 3 belts rather closely placed.

Native species, common in houses, on lawns, and in sandy places throughout country, closely resembling larger headed little "red" or Pharaoh's ant, *Monomorium pharaonis*, in which queen has relatively shorter, thicker abdomen. This was originally an Old World species but is now generally established.

Winged queens mate with winged males usually in fall or spring. Queens lose wings and establish colony in burrow underground. Eggs may develop into workers, queens, or males, though it is probable that males develop from unfertilized eggs. Workers care for queen and larvae, moving larvae and pupae about in colony to places where temperature and moisture are suitable.

These little ants infest houses and lawns and work in definite paths, long lines of them going to and from work along a common highway. Obviously have means of communication with one another, antennae presumably playing an important part in this.

Carpenter Ant
Camponotus herculeanus pennsylvanicus

Workers $\frac{1}{4}$ – $\frac{1}{2}$ in., of 2 kinds, a major worker with a large head, and a smaller minor worker. Male about $\frac{1}{2}$ in. Queen to nearly 1 in. Variation in size of head of workers is distinctive among our equally large Northern ants.

Common in dry decaying trees and timbers, in old barns and houses, particularly where wood comes in direct contact with soil; also in shady woods and other shaded areas, in contrast with many other ants' liking for exposed sunny places.

Life history is essentially like that of ant already considered. Contact of dry wood with soil provides variation in temperature and humidity and allows adults to select suitable quarters for themselves and young. Colonies may remain long-established and become of unusual size.

Food probably largely insects, which are foraged; nests constructed in wood, likely after it has been attacked by fungi. Injury to houses caused by fungi or by termites often attributed to this ant.

Cornfield Ant
Lasius niger americanus

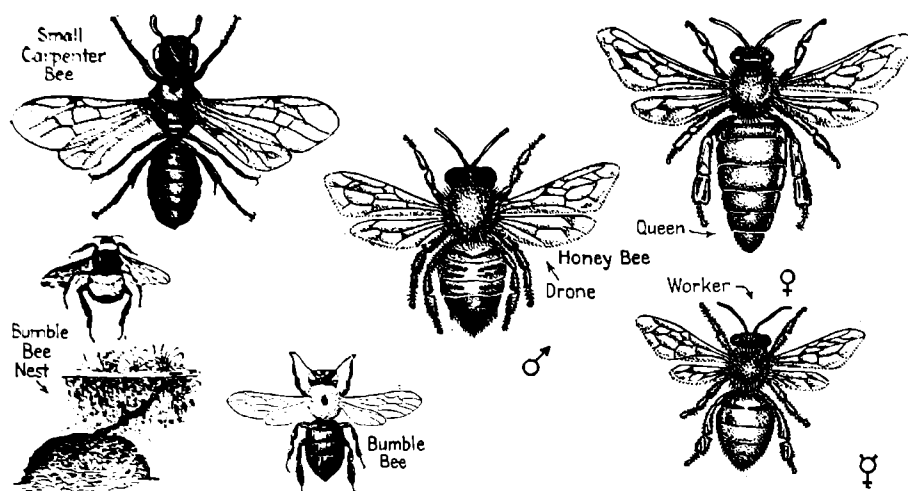
One of commonest small brown ants found in fields and lawns. Queen with large abdomen, relatively small head, and short antennae. Worker with unusually large head, strong jaws, and relatively long antennae.

Found in lawns and fields. Active in soil when temperature is above 70°F. Winged adults found in July–August; most active between 3 and 6 P.M. on bright clear days. At this time, winged adults may be in air in great numbers, through September.

Fertilized queen in fall sheds wings, burrows into ground for winter. First summer lays about 200 eggs and rears about 25 workers. Eggs $\frac{1}{50}$ in. long, white, hatch in 3 weeks into small larvae that mature in 3 weeks and form white silky cocoons $\frac{1}{4}$ in. long for 3 weeks. No males or virgin females in first-year colony.

Food: brood of first year fed from substance of mother and from eggs and larvae of colony, since mother does not seek food; second-year colony may depend on food brought by workers; and may rear 100 new members. Colonies of this species known to increase for 6 years; of others, to 15 years. Ants can survive freezing, 100°F., 24 hours' submergence, month's decapitation. At times queen may lay 100 eggs a day.

Control of ants is most satisfactorily effected by destroying queen and home colony. Since workers feed queen, colony can be destroyed by administration of a poison that will not kill the worker until it has taken food to queen. Such poisons are available. A poison made by dissolving 125 gr. of arsenate of soda in 1 qt. of water in which has been dissolved 1 lb. of sugar and to which honey may be added is put on pieces of sponge that are placed along ant runways. Most drugstores stock effective poisons that are sold at a reasonable figure.



PHYLUM ARTHROPODA. CLASS INSECTA
Order Hymenoptera

Family Andrenidae

Small Carpenter Bee
Ceratina dupla

Length about $\frac{1}{4}$ in. Slender, with metallic blue body and rainbow-tinted wings. Related large carpenter bee is about size of bumblebee, which it resembles. Most easily located by searching for nests.

Found usually in nest in pith of sumac, in dead stubs; entrance rather conspicuous. Also found in other plants that have a roomy, soft pith and dead stubs in which mines may be made, as elderberry or raspberry. Common throughout most of United States.

In early summer female hollows pith of shrub to make deep burrow. In bottom is placed an egg with ample pollen for development of larva. On top of first is a wall and another egg and pollen supply. This is continued up to 14; uppermost and youngest insects must emerge before those lower down can be freed. 2 generations a year. Mother spends winter with brood, in mouth of nest.

Food, pollen eaten by adults and larvae. In getting pollen, insect assists in flower pollination. Female protects burrow containing her eggs or family. Carpenter wasp uses mud instead of wood dust to separate cells of young, and mother does not protect family as does carpenter bee.

Have many enemies, such as skunk and certain insects. May attack horses and other animals that blunder into their nests and may cause severe sting. Usefulness in pollination of fruit trees, clover, and other valuable farm plants cannot be overlooked.

Family Bombidae

Bumblebee
Bombus sp.

Length from $\frac{1}{2}$ in. to over 1 in., depending on species. Usually black and golden yellow; distribution of color distinguishes different species. Abdomen usually plump; wings rather small for such a large insect. Flight relatively clumsy.

Bumblebees found commonly in Old World and in America; most conspicuous in fields of clover or around showy or fragrant flowers; abundant in orchards when fruit trees are in bloom. Females most conspicuous in spring or late fall, workers in midsummer.

Queen lives over winter and starts new colony in spring. Lays 400-1,000 $\frac{1}{8}$ in. white sausage-shaped eggs that hatch in 4-5 days. Larva a hairless, eyeless maggot that matures in about 1 week; enclosed in wax cell in nest. Pupa in tough cocoon in larval cell, for about 10 days.

Food: larvae are fed honey and pollen, first by queen mother and then by workers. In late summer, drones or males and new queens are developed, mate in flight; colony of up to 300 individuals may die, except for fertile queens who seek a sheltered place for hibernation.

Family Apidae

Honeybee
Apis mellifica

Worker or sterile female about $\frac{3}{8}$ in. long. Drones and queens $\frac{3}{4}$ -1 in. long. Swarms of 60,000 bees have been seen, probably constituting one colony. Workers make up most of colony and live only 1-2 months; drones, 1-2 months; queens, several years.

Honeybees are domesticated world over, wherever man can survive and has suitable nectar-bearing plants to provide food for bees. Workers are most commonly seen in fields and about flowers, or near their colonial centers, hives, or bee trees.

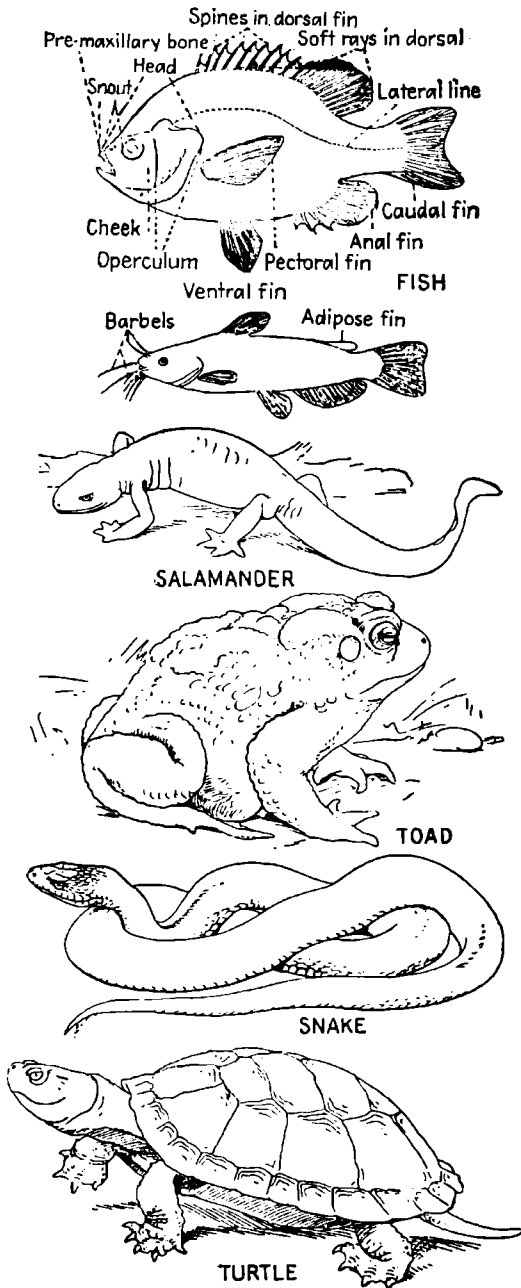
In summer, drones and queens mate in flight. Fertile queen usually starts new colony. Wax comb is built by bees or supplied by man. Eggs laid in comb develop into larvae, then pupae, then adults. From egg to adult queen takes $15\frac{1}{4}$ days; worker, 21 days; drone, 24 days, drones coming from unfertilized eggs laid by queen.

Food of adults, pollen and nectar; of larvae, bee bread of pollen and nectar, prepared by workers. If a colony becomes queenless, a new queen may be developed from queen cells or one may develop from egg or worker larva not over 3 days old, by enlarging cells and changing food from bee bread to a "royal jelly." Drones are killed when of no use to colony.

Possibly most valuable insect for honey produced and for service in pollinating flowers of fruit trees. United States produces about 500 million lb. of honey a year and 10 million lb. of wax. One lb. of honey represents 20,000 trips by a bee, each trip being 1 mile.

PHYLUM CHORDATA

The phylum chordata is composed of animals that are bilaterally symmetric, with a dorsal tubular central nervous system, gill slits at some time in development, and an internal skeleton. It is probable that they have existed on the earth since Cambrian times and certain that they were well established by Silurian times.



A synopsis of groups of Chordata follows.

Division Acraniata, without skull and vertebrae, p. 437

Subphylum Hemichordata (Enteropneusta), p. 437

Subphylum Tunicata (Urochorda), p. 437

Subphylum Cephalochordata (Leptocardii), p. 437

Division Craniata (Vertebrata), with skull or cranium, usually with vertebrae, pp. 438-641

Superclass Pisces, fishes, with gills and 2 pairs of fins suitable for motion in water, pp. 437-451

Class Agnatha (Cyclostomata), without true jaws or limbs. Lampreys, p. 438

Class Chondrichthyes (Elasmobranchii), with cartilaginous skeletons and exposed gill slits. Sharks and rays, p. 438

Class Osteichthyes (Teleostomi), with bony skeletons, covered gill slits, and rayed fins. Common fishes, pp. 438-451

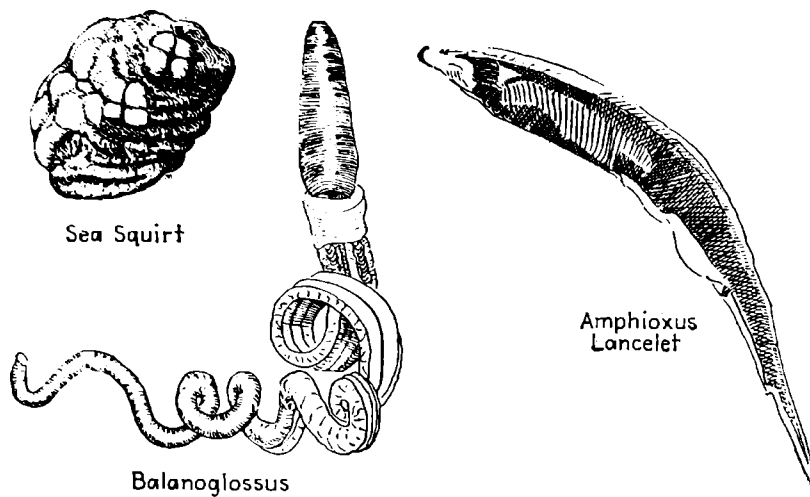
Superclass Tetrapoda, air breathers, with lungs and 2 pairs of limbs suitable for motion on land, pp. 452-641

Class Amphibia, salamanders, toads, and frogs, terrestrial or semiterrestrial, typically laying and developing eggs in water, respiring by gills as larvae and usually by lungs as adults, usually cold-blooded, with soft moist skin, pp. 452-457

Class Reptilia, alligators, lizards, snakes, and turtles, terrestrial or secondarily aquatic, usually coming to dry ground to reproduce, some giving birth to living young while others lay parchment-covered eggs, breathing by lungs, cold-blooded, typically covered with scales or horny plates, pp. 458-473

Class Aves, birds, terrestrial but usually prepared for flight with assistance of feathers, breathing by lungs, laying eggs, warm-blooded, typically without teeth on the jaws though primitive forms did have teeth, with a great variety of wings, beaks, and feet suited to different habits of feeding and locomotion, pp. 474-586

Class Mammalia, mammals, terrestrial or secondarily aquatic, with hair in place of feathers, suckling young at mammary glands, lung-breathing, for most part giving birth to living young, warm-blooded, with teeth in jaws, pp. 474, 586-641



PHYLUM CHORDATA

Animals that at some time in their lives have a skeletal axis (notochord), a central nervous system dorsal to the alimentary canal containing a cavity or series of cavities, and paired slits between outside and pharynx belong to the Phylum Chordata. The sea squirts, birds, beasts, fish, and mammals are in this group.

4 major subphyla are treated in the remainder of this book, and 3 of the 4 are dealt with on this page. The fourth is the Vertebrata.

Subphylum Tunicata (Urochordata)

Sea Squirts, Sea Lemons *Botryllus* sp.

Body of adult a sac varying in size but averaging about 1 in. in diameter. Colonial *Botryllus schlosseri* is purplish or black, jelly-like, over 5 in. across, with 5-10 individuals in groups with a common opening.

Found in masses on piles, rocks, and seaweeds usually in shallow seawater. *B. schlosseri* common along the shore of Middle Atlantic States north and through to Europe with related species to be found in most seas. Over 1,200 close relatives known and described.

Sexes not separate. Eggs of one individual in a colony are fertilized by sperm of another. Free-swimming tadpole-like larva, with long tail, large head, a single eye, a primitive ear, and nerve tube comparable to spinal chord, which become lost in adult stage.

Water enters mouth of colony and through mouth of individual carrying food. It passes through gill slits, which separate food by slime cords that lead to mouth, stomach, and U-shaped intestine. Heart pumps blood first in one direction, then in reverse. Blood stream has corpuscles that attack disease germs. Low-quality brain can be removed from adults without affecting efficiency. Larvae can sense touch, light, and possibly sound.

Serves as scavengers, as food for higher forms, and as interesting subjects of study by zoologists, since adult is less advanced in evolutionary development than larva.

Subphylum Hemichordata (Enteropneusta)

Balanoglossus (*Dolichoglossus*) *kowalevskii*

Length 6-10 in. Body composed of a proboscis that resembles head end of an earthworm, a collar that is relatively free along its forward margin, and a flattened segmented trunk that tapers gradually and regularly to rear end.

Found in mud and sand along seashore, where it burrows like a worm. Other species of genus vary from 1 in. to 4 ft. in length. Group also includes colonial *Rhabdopleura* and *Cephalodiscus* of deep sea. Formerly classified under Annelidae. (See p. 349.)

Sexes distinct; eggs and sperms pass to exterior through pores in parent body. In some species a free-swimming larval state is formed. In others reproduction by the simple process of budding is possible.

Food, organic matter extracted from mud it takes in. Proboscis is hollow and serves as a water-storage chamber. Supported by a short stiff skeletal process that assists in burrowing. This is diverticulum or rudimentary notochord, similar to embryonic notochord in higher chordates. Has rudimentary nervous, circulatory, and excretory systems.

Subphylum Cephalochordata (Leptocardii)

Amphioxus, Lancelet *Branchiostoma* sp.

Length 2-3 in. Semitransparent, fish-like, tail being pointed like a lance giving animal its common name. No distinct head. No lateral fins, but dorsal and ventral fins are supported by rod-like fin rays. Mouth opening is below and in front under a sensory hood.

Lives near shore in various parts of the world, usually buried in sand by day and swimming about actively by night but seasonally abundant for about 9 months. 28 species in the group, 4 American shore forms being *B. virginiae*, *B. floridae*, *B. bermudae*, and *B. californiense*.

Animals are male or female. Breeding season at night and evenings in early summer. Pairs of reproductive organs, normally 26 (but in *B. californiense* 31-33), free germ cells into water where fertilization takes place. Larva is a free-swimming animal but adult burrows in sand with surprising speed.

Food is carried into mouth by stream of water caused by action of wheel organ. Water passes out over gill slits after food has been extracted. Number of gill slits varies from 50-90 pairs. Food is caught in mucous threads before being carried on to digestive system. Respiration effected by circulation of blood through gill slits by which stream of water passes.

Normally not considered economically important, but near Amoy, China, fishermen gather over 1 ton a day for nearly 9 months and use them as an important article of food.

PHYLUM CHORDATA. CLASS CYCLOSTOMATA. Order *Hyperoartia*. Family *Petromyzonidae*

Lamprey

(1) sea lamprey, *Petromyzon marinus*. Length to 3 ft. Dorsal fin not continuous. Teeth radiating variously. (2) brook lamprey, *Entosphenus lamoteni*. Dorsal fin divided. Teeth in radiating groups. In *Ichthyomyzon* dorsal fin is continuous. All of group with unsegmented notochords round jawless mouths, rows of gill openings and no paired fins.

Male builds nest, sometimes with female's assistance. Eggs: (1) over 230,000; (2) over 3,000; laid by (1) in June; by (2) in April. Larvae live as mud lampreys in bottom 4-5 years and transform, fall to spring; (1) goes downstream, living as dangerous fish parasite, then ascends to breed and die while (2) is not parasitic and may be free-swimming less than 1 month. Larvae feed on small animals and plants.

(1) North Atlantic, south to Florida, to northern Europe and northwestern Africa and in many Great Lakes and tributaries. (2) Mississippi system, Minnesota to Pennsylvania, and Great Lakes system, Connecticut and Hudson Rivers, and south to Maryland. Some are eaten by man. Used as cod bait. Some are serious enemies of valuable food and game fishes.

CLASS ELASMOBRANCHII. Order *Euselachii*.

Mackerel Shark. *Lamna nasus*

Length to 12 ft. Narrow at tail base and with horizontal keel. Skin regularly rough. Gill slits on both sides. Male with prolonged pelvic fins forming claspers. Some existing sharks are to 50 ft. long while others are mature at 2 ft.; great variation in shape and habit in different species. Cartilaginous skeletons, exposed teeth and gill slits.

In mating, sharks have internal fertilization, with eggs in some hatching within mother. A 14-ft., 2½-ton white shark or man-eater had 9 2-ft. young, weighing 180 lb., inside her. Shark remains are found laid down in Silurian times. Existing genera are represented back to Cretaceous times. Record line catch, 10½ ft., weight 1,009 lb., 1936.

Family *Lamnidae*

Sharks range the oceans of the world. Mackerel sharks are surface feeders. Mako shark a superior sport animal. Many supply waterproof transparent tissue, valuable livers used medicinally, and oil. (A 9-ft. shark may yield 11 gal. of oil.) Dangerous because of bite and blow of tail. All sharks and rays with persistent notochords and placoid scales with embedded bases.

Ray

(1) common sting ray, *Dasyatis centroura*. Rays include (2) Molubidae, 12 by 20 ft., devilfish or mantas; (3) Pristidae, 15-ft. sawfish; (4) Torpenidae, 5-ft. electric rays; and (5) Rajidae, 6-ft. skates.

Order *Batoidei*. Family *Dasyatidae*

Sting rays are hatched within female's body and may get nourishment there before birth. (5) lays leathery-coated eggs. (2) may weigh to 300 lb., (4) to 100 lb. Food of all, largely crustaceans, shellfish, and fishes. Like sharks but white beneath and with gill openings beneath.

(1) from Maine to Cape Hatteras, with about 30 relatives extending range through warmer salt waters of world. Venom of (1) from tail spine known to have been fatal to man, or spine may cause dangerous wound by breaking off. Surgery is better than the use of potassium permanganate.

SUPERCLASS PISCES. CLASS TELEOSTOMI. Order *Glanistomi*. Family *Acipenseridae*

Sturgeon

(1) American sturgeon, *Acipenser sturio oxyrhynchus*. Body partly plated. Tail unequally forked. Snout conical, elongate. Length to 12 ft. Weight to over 500 lb. (2) lake sturgeon, *A. fulvescens*. 15-16 dorsal shields. Length to 6 ft. (3) short-nosed sturgeon, *A. brevirostrum*. Snout blunt, from ½-¾ length of head.

(1) ascends rivers to above tidewater, May-June. Lays to 3 million heavy sticky, ½-in. eggs totaling 30% weight of parent. Eggs hatch in 3-7 days into ½-in. young that in 1 month may be to 3½ in. long. Migrate to sea at 1-3 years at 3-ft. length. Credited with 300-year life span, probably falsely. Food, small animals grubbed or gleaned from bottom.

(1) North Atlantic, south to South Carolina. In 47 years, New York "take" of eggs ("caviar") dropped from \$6,000,000 to \$5,033.95 a year but is now increasing. (2) formerly common in Mississippi Valley, Great Lakes, and north. (3) marine, from Florida to Cape Cod but becoming generally rare. Spawns in fresh-water streams, as do all sturgeons.

Order *Ginglymodi*. Family *Lepisosteidae*

Gar

(1) long-nosed gar, *Lepisosteus osseus*. Beak length 20 times its least width. Length to 5 ft. (2) alligator gar, *L. spatula*. Length to over 10 ft. Weight to 100 lb. Both gars are covered with bony armor and have jaws armed with sharp teeth. Solid upper part of tail the longer.

Feeds largely on other fishes captured by sudden dashes. Can breathe without use of gills, by using swim bladder as lung in emergency. Often seen at surface taking in air supply. May be caught by slipping piano-wire noose over beak. Apparently makes little provision for care of young.

(1) Great Lakes to Rio Grande and along Atlantic Coast. (2) in Southern states north to Ohio River. Great pests as destroyers of valuable fishes but hosts for young of an edible mussel. Popular sport fish. May be eaten. May be dangerous. Bony coverings used as shields by primitive people.

Bowfin, Dogfish. *Amia calva*

Length of female, to 30 in. Weight to 12 lb. With unique plate under head. May breathe through swim bladder. Male to 20 in. long and with orange border to black tail spot

Male makes circular nest, in weeds, over mud bottom; fertilizes and guards eggs; guards young until they are 4 in. long. Can live in mud short periods without using gills. Hardy, tough bait minnows.

In swamps and lakes from Vermont to Dakotas, Florida, and Texas. Flesh edible when smoked but poor food. Good sport on a line and light rod. Savage fighter that apparently never completely gives up.

Order *Isospondyli*. Family *Megalopidae*

Tarpon. *Tarpon atlanticus*

Length to 8 ft. Weight to over 350 lb. Some scales to 3-in diameter. Rear of dorsal fin much prolonged. Only 1 species known. Closest relative a species of Indian Seas. Hooked, may leap vertically to 15 ft. or horizontally to 30 ft. Matures probably seventh or eighth season, at 4 ft. length. Hardy in foul water.

Spawns along west coast of Florida, March-May, offshore in blue water. Males occur in large schools over shoals 1 mile offshore. Eggs to 12 million per 142-lb. fish, float or sink. Larvae apparently ribbon-like, translucent; undergo sudden change to fish form. 3-in. fish found inshore. Adults run upstream to 100 miles from sea. Disappear in fall.

Supreme game fish. Edible and considered excellent by some if smoked. Sold in Latin-American markets. Scales sold at 5-25 cents apiece. Record fish caught by line are a 247-lb., 89½-in. fish caught in Panuco River, Mexico, in 1938 and 350-lb. fish netted in Hillsboro River, Florida. Found in Lake Nicaragua, Central America. Sensitive to cold.

Order *Isospondyli*. Family *Clupeidae*

Alewife, Sawbelly. *Pomolobus pseudobarengus*

Length to 15 in. Teeth on jaws disappear in old age but persist in fresh-water skipjack or blue herring. Head longer than in hickory shad. Round dark spot on shoulder. Silvery areas on cheeks are longer than deep, while in shad they are deeper than long.

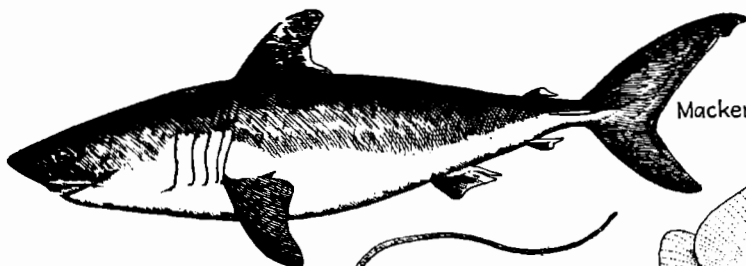
Ascends streams or enters shallows in great numbers in March-April to spawn. Female lays about 100,000 eggs, broadcast. Eggs sticky, hatch in 3-6 days at 60°F. Young to 4 in. by fall, return to sea. Mature in 3 years. No parental care. Landlocked forms die after breeding but others return to sea.

In sea and fresh waters from Nova Scotia and Gulf of St. Lawrence to Gulf of Mexico and in adjacent streams, as in Lake Ontario and central New York. Caught in dip nets or pound nets. Annual yield may reach 30 million lb. and is a major fish resource. Fish eaten fresh, salted, or smoked. Used in making oil and fertilizer.

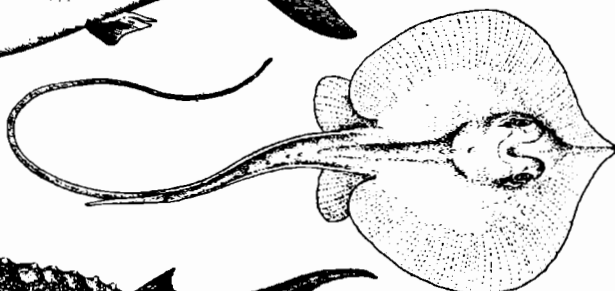
Sea
Lamprey



Mackerel Shark



Sting Ray



American Sturgeon



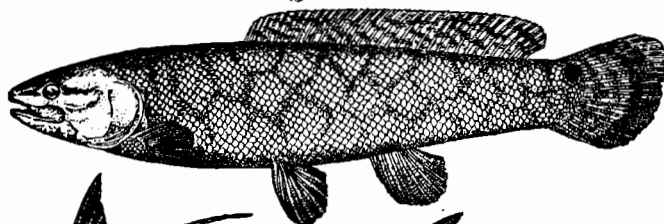
Short-nosed Sturgeon



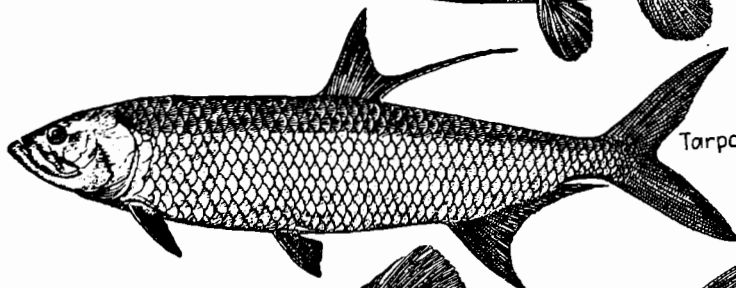
Long-nosed
Gar



Bowfin, Dogfish



Tarpon



Sawbelly, Alewife



PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTOMI

Order Isospondyli. Family Clupeidae

Atlantic Herring. *Clupea harengus*

Length to 18 in. but rarely over 1 ft.; blue above, silvery on sides, with only 1 dorsal fin, with scales that are easily lost. Anal fin with 17 rays. May be to 3 billion in a single small school. See closely related sawbelly.

Spawns in sea though relatives run upstream. Eggs heavy, sticky, sink to bottom, to about 30,000 per female, hatch at 45°F. in 22 days into 1-in. young that mature in 3 years. Length off Nova Scotia at 1 year, 5 in.; at 2 years, 7 in.; at 3 years, 10 in.; at 4 years, 11 in.; at 5 years, 12 in.; at 6 years, 12½ in.; at 7 years, 13 in.; at 9 years, 13½ in.; at 10 years, 14 in., these being large fish.

Trade names: small, to 7 in.; fat, to 10½ in., with little reproductive development; large, over 11 in.; spring breeders, February-April. Both Atlantic coasts. South to North Carolina. California herring, Kauschatka to San Diego. Fry 3-4 in.; fried crisp, "whitebait"; larger, canned as "sardines"; full-grown, fresh or dry, "red herring"; lightly salted, smoked, canned, "kippered herring"; larger well-salted and smoked, "bloaters."

American Shad. *Alosa sapidissima*

Length to 2½ ft. Weight to 13½ lb.; average 1 ft., 1 lb. Jaws toothless; upper deeply notched. Cheeks deeper than long.

Males precede females in spring run up streams. Female lays to 156,000 non-sticky, ¼-in., slowly sinking eggs that at 60°F. hatch in 1 week. Larvae ½-4½ in. for about 2 weeks. By first summer, reach 3-5 in. fingerling and return to sea. Young 6 in. by first winter. Mature at 3-8 years.

Found in sea and adjacent tributaries from Gulf of St. Lawrence to Florida. Reduced by pollution and overfishing but by managed 40% harvest, pollution correction, and dam removal they may be restored. One of most sought fishes. Has been introduced and established in California.

Menhaden. *Brevoortia tyrannus*

Length to 18 in.; average, under 12 in. Head large. Anal fin small. Scales deep, with rear edge roughly toothed or fluted. Long thin gill rakers, used in straining out plankton food, seem to fill mouth. Usually found in large schools.

Eggs float just beneath surface; hatch at 72°F. in 2 days. In first year, reach 6 in. and weight of 1½ oz.; in second year, 10 in.; 7 oz. Mature in about 3 years. Mature fish usually caught in fall on way to unknown spawning grounds where it remains until next spring.

Nova Scotia to Brazil, in coastal waters largely. Too rich in oil to be popular as food. Oil is extracted and residue is used as fertilizer. Annual New England catch around 600 million lb. Roe is canned and oil is used considerably in poultry foods.

Order Isospondyli. Family Coregonidae

Great Lakes Whitefish. *Coregonus clupeaformis*

Has small adipose fin like salmon and trout but mouth is small and upper jaw reaches only to eye. Length, 5 months, 2-3 in.; 1 year, 8-9 in.; 2 years, 12-15 in.; maximum, 24 in. Weight to 23 lb. Olive back with white sides.

Spawns November. Eggs laid in shallow water, over rocks up to 10,000 per lb., ½ in.; hatch in 5 months. Males do not breed until 2½ lb. and females at 3½ lb., while legal minimum harvest size is 2 lb. Oldest fish known was 26 years old. Food, small animals such as shrimps and insects.

Ranges from Great Lakes north to Arctic Circle. Captured by deep-water trap nets. Annual United States take, about 4½ million lb., being most valuable food fish of Great Lakes but in danger of extermination or becoming of little importance. Fish are marketed fresh or smoked, or roe is sold as caviar instead of sturgeon eggs.

Order Isospondyli. Family Salmonidae

Pacific Salmon

(1) king, chinook, or spring, *Oncorhynchus tshawytscha*; (2) red, sockeye, or blueback, *O. nerka*; (3) silver or coho, *O. kisutch*; (4) pink or humpback, *O. gorbuscha*; and chum, keta, or dog, *O. tshawytscha*. Weight: (1), 100 lb.; (2), 7 lb.; (3), 10 lb.; (4), 6 lb. Anal fin rays: (1), 15-17; (2), 14; (3), 13-15; (4), 14-16.

(1) and (2) swim upstream for long distance in July-October at age of (1) 3-8 years, (2) 4-8 years. (3) at 2-7 years and (4) at 2 years swim upstream in September-November. Female builds nest, mates, spawns, and dies. Young of (1) return to sea after few weeks at length of 1½ in.; young of (2) return to sea after few months to 3 years; young of (3), after 1-2 years at length of 5 in. Dark side part marks are broad in (1), round in (2), absent in (4).

Eggs used as bait, hatch at 50°F. in 50 days. Most valuable food fish; in Columbia River alone, yield has been worth 10 million dollars a year to 25,000 people, with total once to 32 million dollars. From Alaska to California, finest of all sport fishes. Federal dams in state of Washington will affect fish considerably.

Salmon-Rainbow Trout

(1) Atlantic salmon, *Salmo salar*. With small black or brown spots on light background, without broad pink lateral stripe of rainbow trout. Least depth under ¾ distance from anus to tail but over that in landlocked salmon. (2) rainbow trout, *Salmo gairdnerii*. Adults with broad pink side band, with brown spots on tail; young, with dark spotted or margined adipose. Length, 5 months, 2-3 in.; 1 year, 4-6 in.; 2 years, 8-9 in.

Migrates upstream to spawn February-June. Female builds nest in riffle in gravel. Eggs 200-21,000, heavy, not sticky, ⅓ in., fertilized and abandoned; hatch at 57°F. in 22 days; known to grow 1 in. a month at 63°F. under ideal conditions. Breeding male of (2) shows conspicuous rosy side bands. Both species breed more than 1 year, thus differing from Pacific salmon. Weight of (1) to 103 lb.; of (2) to 40 lb. Line record, 37 lb., 40½ in., 1947.

(1) formerly important food and game fish from Delaware north along Atlantic Coast; now practically gone in United States; some resident in lakes and some found in Maine. Originally in Hudson River. (2) native of Pacific Coast but widely established over world. Superior food and game fish that can survive 83°F. water temperature if acclimated. Possibly at best in streams connected with sea, though record fish caught elsewhere.

Brown Trout. *Salmo trutta*

Yellow-brown with black or brown spots only slightly developed on tail, with red spots often blue-bordered and adipose of young, orange. Lower fins white or pale yellow. Scales larger than in brook trout. Length, 5 months 2-3 in.; 1 year, 4-6 in.; 2 years, 8-9 in.

Spawns in fall, running upstream to shallower water and breeding much as does brook trout. Eggs hatch in 31 days at 57°F.; fertilization about 99%. Nest abandoned. May breed year after year. May breed in water to 4 ft. deep but more commonly in shallower waters. Weight to 40 lb. Line record, 39½ lb., 1866.

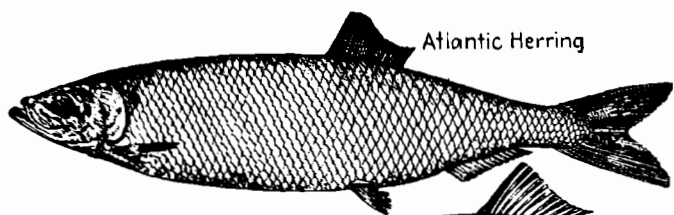
Introduced from Europe and widely established. Will drive out brook trout in quieter warmer waters. Can survive water temperature at 81°F. but prefers cooler. Crossed with true Loch Leven trout, which were introduced into America in 1884. May be of the same species.

Cutthroat Trout. *Salmo clarki*

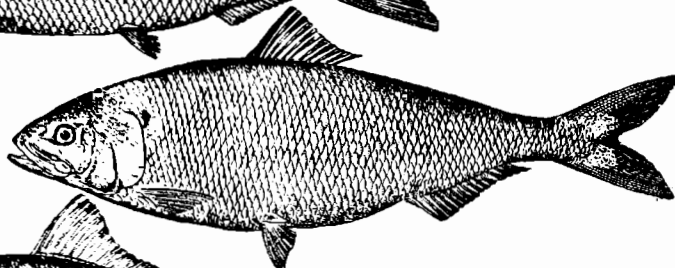
Weight to 41 lb. Anal rays, 10. Commonly heavily spotted with black. Sides without red spots. Red usually under jaws on each side. Scales rather coarse. Breeding male shows rose band on sides like that of rainbow trout. Line record, 41 lb., 1925.

Spawns in spring, in nest built by female. May be crossed in hatchery or in nature with rainbow trout but such eggs are not viable. Some ascend rivers short distances from sea. Lake forms go up adjacent swift streams to breed. Voracious feeders like their relatives.

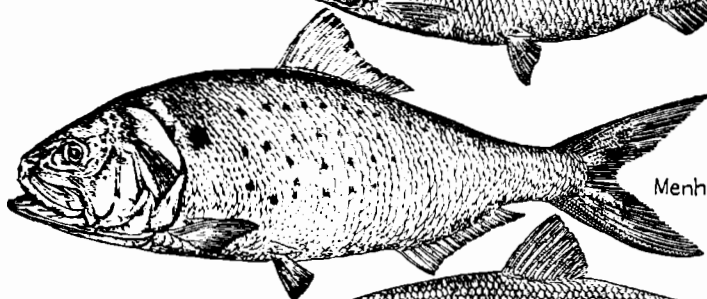
Excellent sport and game fish in West, some found east to Montana and Yellowstone; present in most Pacific Coast streams. Destroys many eggs of salmon and rainbow trout, as does rainbow itself, and has been subject to bounty in some places because of this.



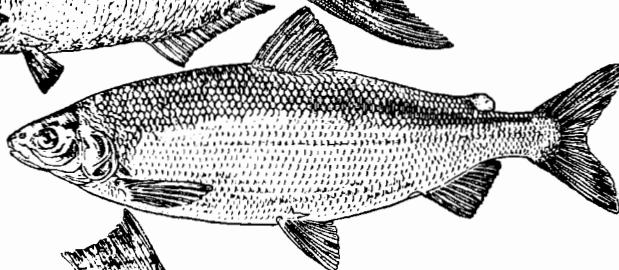
Atlantic Herring



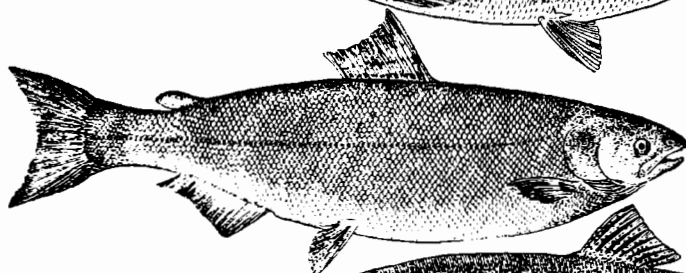
Shad



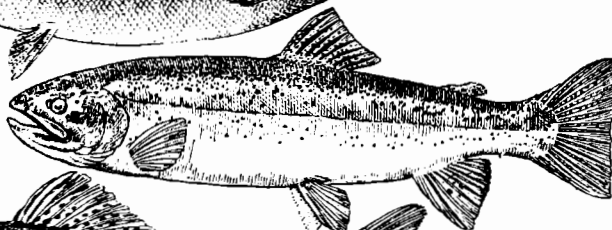
Menhaden



Whitefish



Pacific Salmon



Rainbow Trout



Brown Trout



Cut-throat Trout

PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTOMI

Order Isospondyli. Family Salmonidae

Lake Trout. *Cristivomer namaycush*
Length, 5 months, 2-3 in.; 1 year, 6-7 in. Weight to 80 lb. No red spots but large white spots show on sides and back against a darker background. "Cristivomer" refers to toothed crest of bone in roof of mouth. Line record, 63 lb., 47½ in., 1930.

Breeds over hard bottoms, in water 3-20 or more feet deep, a 24-lb. fish laying to 15,000 eggs. Eggs suitable for rearing in hatcheries but it is believed fish do not live in waters usually stocked by hatchery-reared fish.

Found in large cool lakes from New England to Montana, British Columbia, and Alaska. Great Lakes region a valuable source of commercial fishing. Supply decreasing dangerously because of modern techniques of net fishing. With wise management should be abundant.

Brook Trout. *Salvelinus fontinalis*
Length, 5 months, 2-3 in.; 1 year, 4-6 in.; 2 years, 8-9 in. Weight to 17 lb. Back with worm-like markings. Body red-spotted. Lower fins with white, black, and orange. Color varies with bottom, food, and other factors. Flesh firm. Superior food.

Starts upstream about October, males first. Female makes nest in riffle over gravel and mates. 3-year fish lays 100-300 eggs; older, to 5,000; in nature 80% fertile; hatch in 44 days at 50°F.; in 90 days at 40°F. Male may guard nest 3 weeks. May spawn at 2 years, at 8 in. in length. Line record, 14½ lb., Nipigon River, 1916.

Found in streams with maximum temperature of 66°F. but can survive to 75°F. Labrador Peninsula to Georgia, Montana, and Saskatchewan. Sea-run in Labrador. Introduced all over world in suitable waters. In some places as in eastern United States freed from hatcheries at legal catching size often only a few minutes before taken.

Order Isospondyli. Family Osmeridae

Smelt. *Osmerus mordax*
With form of salmon, but with larger scales and with large teeth in jaws. Related to the marine capelin. Length to 14 in.; average, 8 in.

Enter streams of fresh and brackish water early spring. 2-oz. fish may lay 50,000 heavy sticky minute eggs and return to sea.

Gulf of St. Lawrence to Maryland and landlocked in various Eastern lakes. Other smelts are found along the Pacific.

Order Enchelycephali. Family Anguillidae

Common Eel. *Anguilla bostoniensis*
Length to 5 ft. Skin with minute scales partially in groups. In some other eels as conger, pike, worm, and snake eels, skin is scaleless. Male rarely over 3 ft. Migrate downstream to sea to breed.

Lays to 100,000 eggs, deep in sea south-east of Bermuda. Young *leptocephali* first year are flat, transparent, to 3 in. Second year ascend rivers, reaching to 8,000-ft. elevation. Remain inland for 8 or more years, returning to sea to breed and die. May spend winter buried in mud.

Valuable food fish caught mostly on downstream migration. Males rare in fresh water. Eels of different species found all over world except Pacific Coast of North America and a few Pacific islands. European eels breed in Atlantic. Annual United States catch worth about \$250,000.

Order Eventognathi. Family Catostomidae

Buffalo
(1) bigmouth buffalo, *Megastomatobius cyprinella*. Depth 3 or more in length; Mouth large. (2) black buffalo, *Ictiobus niger*. Depth 3 or more in length. Mouth small. (3) white buffalo, *bubalus*. Depth under 3 in length. Mouth small.

Food, (1) and (2) from bottom; (3) less so. Weight of (1), 10-50 lb.; of (2) and (3), to 35 lb. Flesh coarse and flat but edible. Breeds March (south), May (north) often crowding shallows with enormous schools and then may be caught with pitchforks.

(1), Mississippi Valley to Winnipeg and in lakes. (2) and (3), Mississippi Valley in larger streams and in Great Lakes. A poor but acceptable food fish; welcome where nothing better is available. Survives temperatures not suitable to many better species.

Common Sucker. *Catostomus commersonii*
Length, 5 months, 1½-2 in.; 1 year, 2-3 in.; 2 years, 5-7 in. Maximum to 28 in. Mouth with sucking lips, as in all suckers. Scales small. Flesh bony and usually soft.

In early spring run upstream. Breed in swift water, in shallow gravel, pushing bodies into gravel. Young unprotected; swim near surface and feed about 10 days, then take to bottom. Some mature at 6 in. Adults may return to deep water to await breeding season.

Ranges Labrador to Montana, Georgia, and Missouri with over 60 American species and 2 of eastern Asia. Over 3 in., eat small animals and may destroy fish eggs. Caught by hook and line or speared over spawning bed. An inferior but popular food fish.

Order Eventognathi. Family Cyprinidae

Goldfish *Carassius auratus*
Well-known aquarium fish, usually red and white but some black and brown, with relatively large scales and often with unusual eyes and fins. Brown in nature. Length to over 18 in. Originated in Orient but established over world.

Mates during day, April-May, laying 10-20 amber sticky eggs at a time to total over 500 which stick to supports, hatch at 70°F. in 3-7 days. Good breeder has 2-in. body or longer, matures second year; breeds until 9 years and may live to 15 years. General scavenger.

Originated in Orient. Best in water containing lime, between 70-55°F. Has good commercial value for aquarium stock. In ponds, water enriched by mixture of ½ sheep manure and ½ superphosphate fertilizer, which encourages food eaten by goldfish.

Carp. *Cyprinus carpio*
Coarse-scaled, soft-fleshed, dark-backed, brownish or golden-sided, with 4 barbels near mouth. Length, 5 months, 3-5 in.; 1 year, 6-8 in.; 2 years, 12-15 in. American maximum weight, to 42 lb., 1930. Swiss, 1825 record, 90 lb.

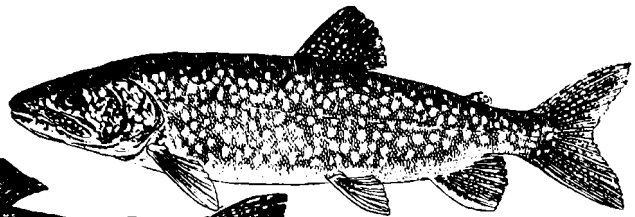
In New York breeds May-June, a 6-lb. fish laying to 2 million eggs which hatch in 5-12 days. Breeds and feeds in shallow water. Matures in 2-3 years. Does not protect young. Food, smaller plants and animals strained from bottom muds.

Supplants superior fish by destroying plants and nests, eggs and young. Some 250 tons harvested in New York as cheap food and to protect more valuable species. Found in fresh waters native in Asia and Europe and introduced unfortunately to American waters.

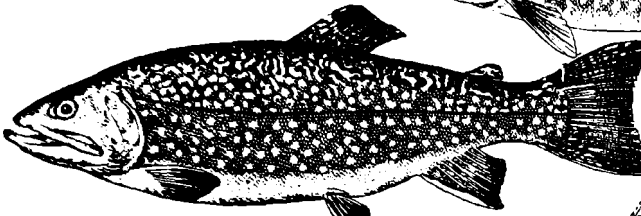
Golden Shiner. *Notemigonus crysoleucas*
Length, 5 months, 1 in.; 1 year, 1½-2 in.; 2 years, 2½-3 in. Maximum 12 in. Golden-green in upper parts, with silvery sides and yellow fins. Breeders' bodies yellow. Lateral line follows outline of bottom of fish.

Spawns in sods, on water plants, brush, or submerged roots. 10 pairs of young need pond 3 by 30 by 100 ft., supplied with 14 bushels fresh barnyard manure and 15 qt. soybean meal in May; and for rearing, with 15% cottonseed meal and fish meal.

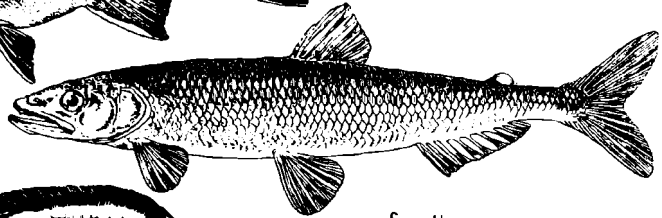
May eat plant materials and thrive but will raid fish nests of more desirable species. From Nova Scotia to Dakota, south to Tennessee and Texas. Raised as bait minnows, ½ acre may yield 4,000 worth \$40 wholesale.



Lake Trout

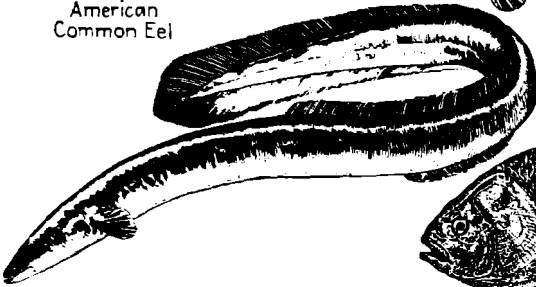


Brook Trout

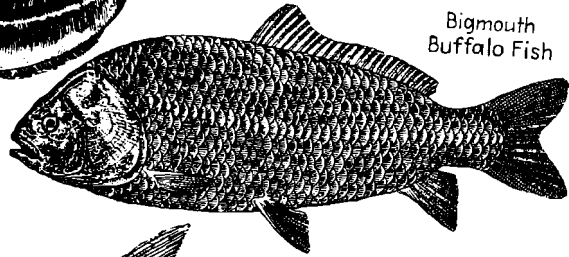


Smelt

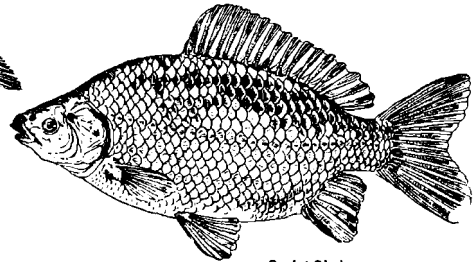
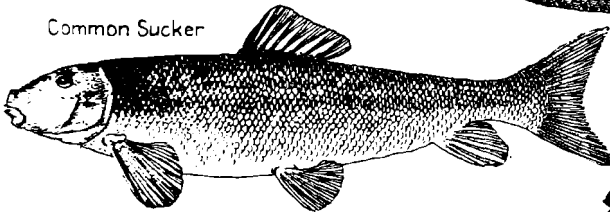
American
Common Eel



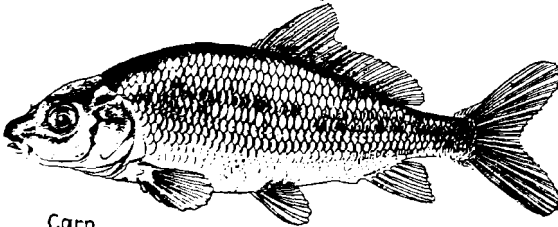
Bigmouth
Buffalo Fish



Common Sucker

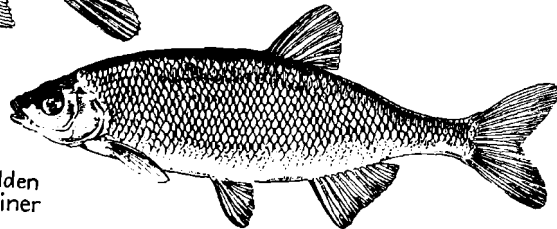


Goldfish



Carp

Golden
Shiner



PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTOMI

Order Ewantognathi. Family Cyprinidae

Horned Dace, Creek Chub. *Semotilus atromaculatus*

Length 5 months, 1-1½ in.; 1 year, 1½-2 in.; 2 years, 2½-4 in.; maximum, about 10 in. Scales crowded in front of dorsal fin, which has dark spot at base. Sides and belly silvery. Breeding male steel-blue above and with tubercles on head.

Male builds nest, May-July, moving pebbles to make circular pit with upstream ridge of gravel and sand. One or more females enter, mate, and lay eggs. Nest guarded temporarily by male at least while he is in breeding mood. Active. Food, chiefly small aquatic animals.

Common in small streams from Maine to Wyoming, south to Alabama and New Mexico where nests are conspicuous above riffles. Edible. Attractive fish to small boys because it bites readily but is inferior to associated trout. Takes artificial fly rather readily.

Black-nosed Dace. *Rhinichthys atratulus*

Length to 3 in. Slender, active. Males in spring breeding, with orange pectoral (fore) fins. Scales small.

Breeds in moving water over gravel bottom. Food, chiefly small animals (for example, 70% midge larvae and 17% May-fly larvae), sometimes fish eggs.

In clear brooks, from New England to Minnesota and Nebraska south to Alabama, varying much through range. A most interesting aquarium fish.

Common Shiner, Redfin. *Notropis cornutus*

Length to 8 in. Scales large. Back dark steel-blue. Sides and belly silvery. About 100 related species. In spring, male is pink-sided, roughened in front of dorsal fin and larger than female.

Male builds nest in shallow swift water. Eggs laid by many females in 1 nest when temperature is about 73°F. Nest made by rooting in gravel, May-June. May use nests of other species. Male defends nest but not young. Less than 50 orange eggs laid at a time. Incubation period unknown.

Common in streams east of Rocky Mountains to north of Texas and James River in Virginia. Related species extend range south. Attractive aquarium fish. Hardy bait minnow. Does not compete for food with more valuable game species except possibly for surface insects as in a trout stream.

Blunt-nosed Minnow. *Hyborhynchus notatus*

Length to 4 in. Olive with bluish sides, dusky toward base of dorsal fin; with black blotch toward base of dorsal fin in breeding male.

Breeds in June. Eggs placed singly on flat undersides of submerged objects in patches to 6 in. long; attended by male, whose head in spring is wholly black. Snout tubercled.

Variably abundant Quebec to Dakotas, south to Gulf States. Commonest in shallow rivers over stones or vegetation. Important bait minnow. Young lack black on dorsal surface.

Cutlips Minnow, Nigger Chub. *Exoglossum maxillina*

Length to 8 in. Compact, dark, with lower jaw conspicuously 3-lobed, unlike most other minnows. Fins plain. Breeding male dark to almost black and longer than female.

Male builds 18 by 5 in. nest of ½-in. flat stones, May-June, in 3-30 in. of slowly moving water at 70°F.; fights off other males, mating successively with many females. Eggs ¼ in., yellow, glossy; hatch in 4 days; young leave nest after 6 days.

Abundant in slowly moving streams from Vermont to Virginia. Trout fishermen frequently catch it. Never large enough to be important. May be considered as food for other species and enemy to their young. Fair as a bait minnow. Relatively hardy.

Order Nematognathi. Family Ameiuridae

Bullhead, Horned Pout. *Ameiurus nebulosus*

Length, 5 months, 2-2½ in.; 1 year, 3-4 in.; 2 years, 5-7 in.; maximum, 20 in. Mouth large. Scales lacking. Barbels conspicuous. Dark to silvery. About 1,000 species known. Taste organs along undersides. Related Mississippi catfish caught in 1878 weighed 150 lb.

Mates in late spring. Eggs laid in nest built and guarded by male. About 2,000 ¼-in. eggs, incubated about 5 days, often by male removing silt. Coal-black young stay in school protected by male during early part of summer of first year, the schools making conspicuous dark patches in water at times.

Common in quiet warm mud-bottomed waters from Maine to Dakota, south to Texas and Florida. Introduced in California. Superior pan fish, and popular with young fisherman. Excellent food with ready market. Spines of pectoral and dorsal fins locked can inflict painful injury. Can live out of water rather long time.

Order Haplomi. Family Esocidae

Chain Pickerel. *Esox niger**

Length to 2 ft. Cheeks and gill covers, entirely scale-covered. Mouth larger, terminal, well-armed with sharp teeth. Scales small and mostly uniform. Scales in lateral line, about 125.

Mates early spring, in shallow weedy water, producing several thousand eggs fertilized as parents swim side by side; no nest. Eggs hatch in 2 weeks, not sticky. Young unprotected. Food, any animal that can be overcome.

Common in ponds and streams among vegetation from Maine to Florida, west to Great Lakes and Mississippi basin. Excellent game fish, intolerant of competition; good food but bony, so unpopular with some fish specialists.

Pike, Jack Pike. *Esox lucius*

Length, 5 months, 5-7 in.; 1 year, 8-12 in.; 2 years, 14-17 in. Maximum to over 4 ft. Weight to over 46 lb. Blue or greenish-gray. Scales appear small. Cheeks entirely scaly, but gill covers unscaled on lower half. Markings in adults, whitish spots.

Breeds in spring in shallows. Parents swim side by side, dropping and fertilizing over 100,000 ¼-in. nonsticky eggs among weeds. Eggs hatch in 2-3 weeks, without parental protection. Food almost entirely other fishes caught by sudden darts. Line record, 46½ lb., 52½ in., 1940.

Superior game fish with excellent food qualities. Can be reared in hatcheries but is not commonly so treated. From Alaska to New York and Ohio, also in northern Europe and Asia. Introduced and established elsewhere where conditions are suitable. Feed best at 60-80°F.

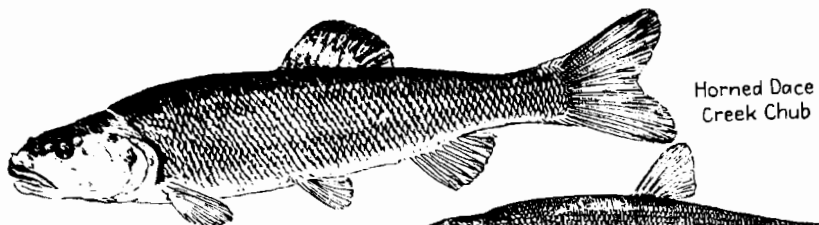
Muskellunge. *Esox masquinongy*

Length to 8 ft. Weight to 75 lb. Lower halves of cheeks and gill covers scaleless. Markings, dark spots or bars. May possibly hybridize with pike even in nature. Line record, 62½ lb.

Mates at 35-50°F.; spawns at 50-60°F., April-June, often in shallow streams. A 35-lb. fish lays to 265,000 eggs, each ½ in. through, not sticky. Young and eggs not protected by parents. Food entirely other animals, mostly fishes.

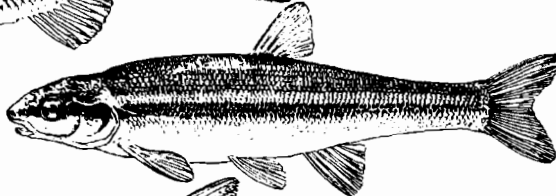
Lakes and large rivers of Great Lakes region, occasionally in Ohio Valley, or even to North Carolina and in Tennessee River system. One of best game fishes. Good food. Highly destructive to associated fishes. Feeds best at 60-80°F.

* *E. vermiculatus* illustrated.

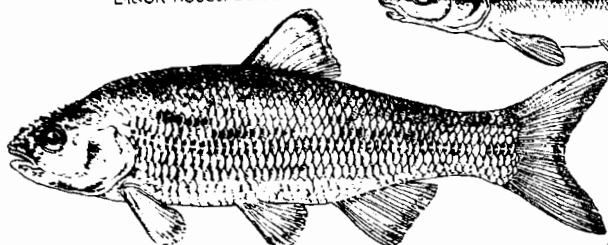


Horned Dace
Creek Chub

Black-nosed Dace



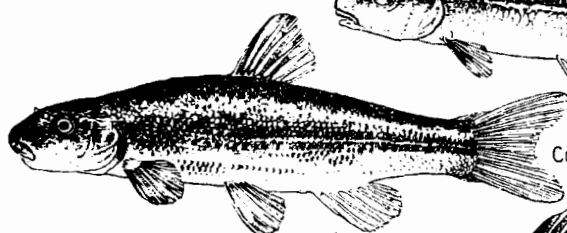
Common Shiner



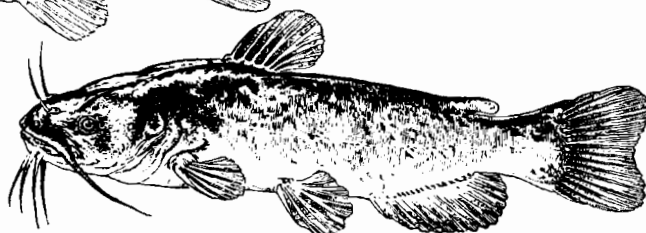
Blunt-nosed Minnow



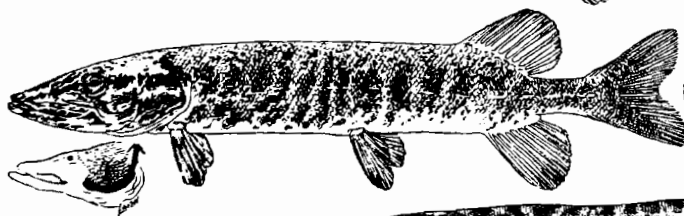
Cut-lips Minnow



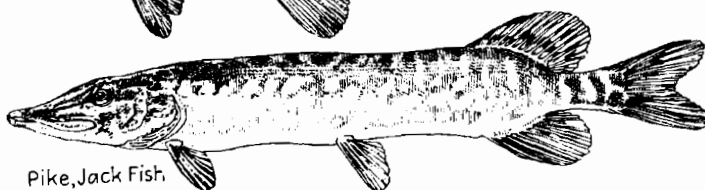
Bullhead
Horned Pout



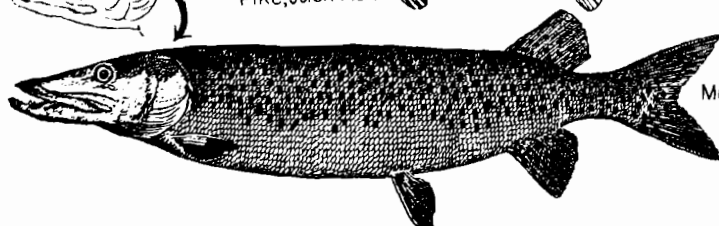
Pickerel



Pike, Jack Fish



Muskellunge



(The pickerel illustrated is *Esox vermiculatus*.)

PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTOMI

Order Cyprinodontes. Family Cyprinodontidae

Killifish, Top Minnow. *Fundulus* sp.
Well over 100 species. Length to 4 in. Lower jaw extends up and beyond upper. Anal fin normal, not sword-like as in male *Gambusia*. Tail not sword-like. Males smaller, more brilliant than females.

Sail-finned Killifish. *Molliensia latipinna*

Length to 3½ in. Male with extraordinarily large dorsal fin which is expanded in courtship. Olive, with dotted brown spots on sides. Tail marked with iridescent light blue. Rarely entirely black (1 in several million).

Eggs fertilized outside female and young develop outside mother. Food almost entirely small forms of animals like mosquito wrigglers, caught at or near surface. See *Gambusia* below for different reproductive story.

Found in fresh and brackish waters of Europe, Africa, and America. One common species, *F. heterochilus*, ranges Maine to Mexico. Satisfactory aquarium fish. Excellent mosquito control in pools that do not dry completely.

Eggs fertilized in mother, development varying with temperature from 6 weeks to 6 months, though shorter time is more common. Change of water may hasten delivery when a dark spot near vent indicates imminence. Young, well-developed; breed at 3-6 months.

Native of southeastern United States and Mexico. In nature, live in salt, brackish, or fresh water. Aquarium-kept fish should be treated periodically with salt solution in increasing strength, beginning with 2 tsp. to 1 gal. of water and adding 1 tsp. a day for 3 days.

Order Cyprinodontes. Family Poeciliidae

Guppy, Mosquito Fish

Term includes many, such as *Gambusia affinis*. Length to 2¼ in. Grayish, black, or black-blotched. In related 2-in. guppy *Lebistes reticulatus*, male is mottled silver, black, red, or blue.

Swordtail. *Xiphophorus helleri*

Length to 4 in., exclusive of sword. Active. Brilliant olive brown on back; brownish-green, blue, blue-green, or steel-blue on sides, with longitudinal red or red-brown stripes and sometimes 3-5 vertical bars on fore part of body and 1-2 at base of tail. Female larger than male and swordless.

Blue-moon Fish, Platy. *Platypoecilus maculatus*

Length to 3 in. Variable from light gray with tail crescent, to red, yellow, or black.

Killifish, with males with sword-like anal fins, fertilize eggs within female. Young born alive; must be freed among vegetation to escape being eaten by own kind. Raising water temperature induces breeding.

One male breeds with 4-6 females at 72-76°F. Young born in 6-8 weeks, numbering 30-200. In aquariums, young must be freed in weeds or traps to survive destruction by parents. Female should not be placed again with male until 1-2 weeks after bearing young. Sexes of young indistinguishable at first but should be separated when recognized.

Gambusia is native of New Jersey on to Mexico; *Lebistes*, from Venezuela to Trinidad. *Daphnia* (see p. 369) make excellent food for guppies in aquariums. Guppies are excellent material for studying heredity.

Native of fresh waters of Atlantic slope from southern Mexico to Guatemala. Imported into Europe in 1909 as aquarium fish known as "Mexican swordtail." Probably easiest of aquarium fishes for amateurs to work with, and one of most satisfactory as classroom animal. Hybrids between *Platy-poecilus* and this species show many interesting variations.

Female, 3 in.; male, 2 in. Male scarlet and black. Reproduction somewhat similar to the above, with crosses possible in nature.

Native of Mexico. In aquarium should be kept at around 70-85°F., with 60°F. dangerously low. Used commonly in study of heredity and as ornamentals by fish fanciers.

Order Cyprinodontes. Family Anabantidae

Fighting Fish. *Betta splendens*

Length to 2 in. Anal fin enormous. Tail rounded. Body velvety brown to black, with glittering metallic dots. Eye green, with red behind eye and on anal and tail fins. Female with anal fin less pointed than in male.

Males fight each other fiercely, tearing each other's fins. Male builds bubble nest. Female lays few eggs. Male fertilizes them, floats eggs with bubble into nest, and guards them until they swim a few days after hatching. Hatch in 2 days at 80-90°F.

Used as fighting fish in Thailand, where they are native, bets being placed on possible winners. Popular aquarium fish in America since 1927. Young may be eaten by guarding male when unable to swim. Feed on *Daphnia*. Independent in 1 month. All carnivorous.

Order Syngnathidae. Family Exocoetidae

Flying Fish. *Parexocoetus mesogaster*

Flying fishes vary in length from 2-in. Monroe's flying fish to 18-in. California flying fish. Short-winged flying fish (illustrated) is 7 in. long; in flight, shows 4 wings, the forward light and unpatterned.

Little published about reproductive habits. Some species rise to 4 ft. above water and go to ¼ mile through air. Most glide without a wing flutter. Live in schools and take to air in swarms before ships or preying fishes.

Shortwinged is common from Cape Hatteras to Florida and in Gulf Stream. Other species include 2-winged Caribbean flying fish and the California flying fish found off Santa Barbara and well known to tourists; an excellent food fish.

Order Thoracostei. Family Syngnathidae

Sea Horse. *Hippocampus hudsonius*

Length to 6 in. Tail prehensile. Gills in tufts. Swims by movement of dorsal fin but normally remains with tail coiled about seaweed. Male with pouch in front which extends from twelfth to eighteenth body ring. Spotted sea horse *H. punctulatus* has 10 trunk rings instead of 11 and is spotted.

Mates in spring. Female produces about 200 eggs which she places in male's pouch, process taking 1-2 days. Male incubates eggs 40-50 days until young, with remnants of yolk sac, are born. At first, young swim in horizontal position even after developing prolonged snout. Sex differences apparent after few months. Reach maturity in 1 year.

H. hudsonius found uncommonly in seaweed from Nova Scotia to Florida. Spotted sea horse ranges north to New Jersey. Other species common in warmer seas, particularly in Mediterranean. Dried bodies used as ornaments and when ground up believed by superstitious to have unique medical properties. Always popular in marine aquariums.

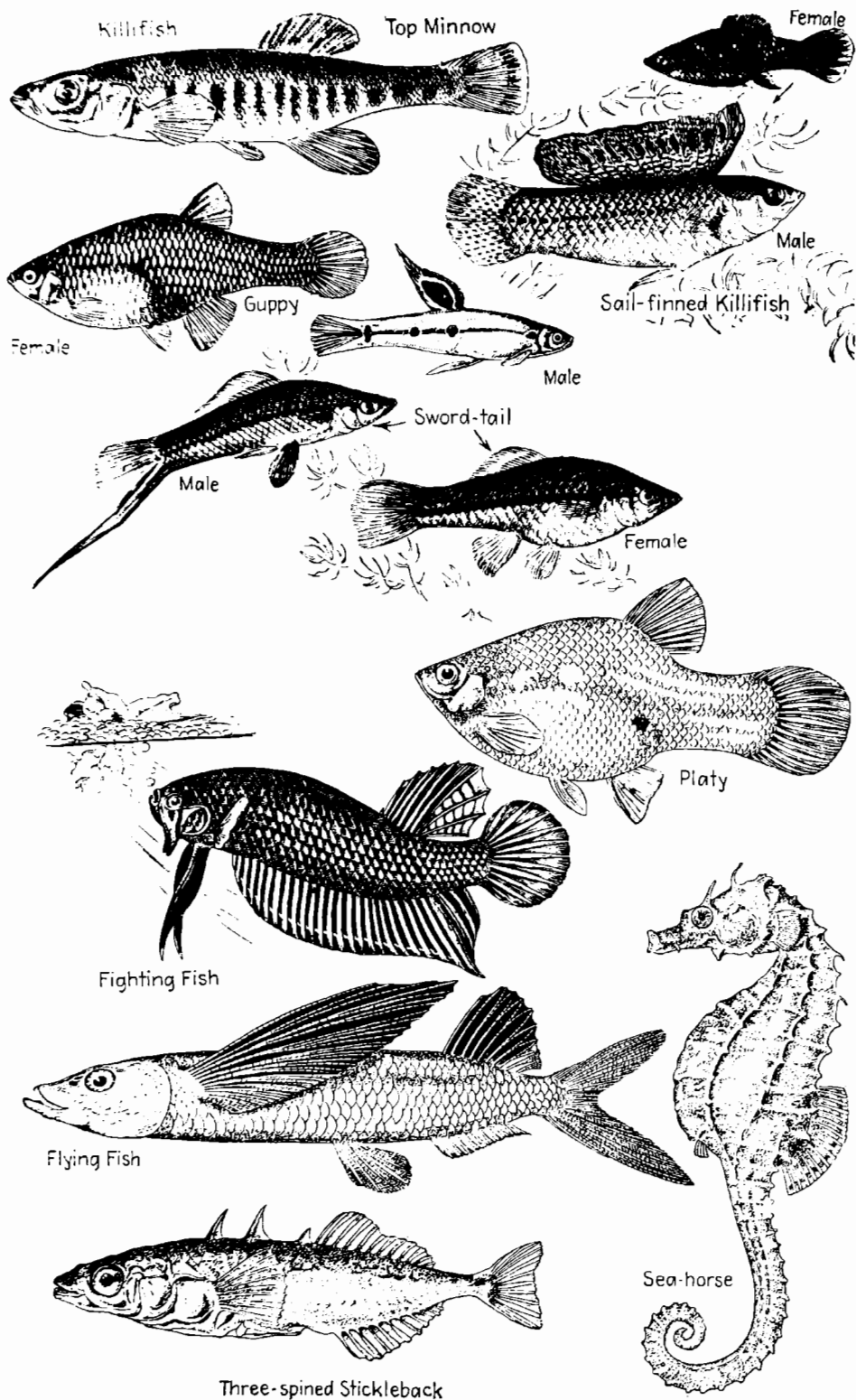
Order Thoracostei. Family Gasterosteidae

Brook Stickleback. *Eucalia inconstans*

Figure is of related *Gasterosteus aculeatus*. Brook stickleback is to 2½ in. long, with 5 dorsal spines and naked body. Other species, with plates on sides as shown and with 9, 4, 3, or 2 dorsal spines. Males usually smaller and darker than female.

Male builds hollow nest of plants cemented with mucus, size and shape of walnut. One or more females fill nest with ¼-in. eggs (to 300 per female), which are fertilized by male, put in nest, and guarded by him during 10-day incubation period, until young are independent. Breeds at 1 year and dies at 1½ years or less.

Common in small brooks, Maine to Kansas and northwest to Saskatchewan, with related species in seas and fresh waters of Europe and Japan. Young are ¼ in. long when hatched and at 72°F. may triple size in 6 weeks. Interesting in aquariums.



PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTEI

Order Acanthini. Family Gadidae

Codfish. *Gadus callarias*

Length to over 6 ft. Weight to 211 lb., but 50 lb. normally a large fish; average, 25 lb. Dark-spotted, with light-colored lateral line. Chin with barbel. Dorsal fins, 3. Anal fins, 2. Tail, small and square.

Probably spawns promiscuously in great schools. A 70-lb. fish may free over 9 million buoyant, $1\frac{1}{6}$ -in. non-sticky eggs a season, which hatch in 17 days at 40°F. Food, plants and animals grubbed from bottom while schools of fish swim close to bottom.

In salt water, at depths to 1,500 ft., off both coasts of Atlantic, south to Virginia but uncommon south of New York. Probably world's most valuable fish as food for man, source of cod-liver oil, rich in fat-soluble vitamins A and D, useful in preventing rickets.

Order Heterosomata. Family Pleuronectidae

Winter Flounder. *Pseudopleuronectes americanus*

Length to 18 in., with record to 20 in. and record weight to 5 lb. Both eyes on one side of body, with fish lying on bottom on other side. Fins nearly encircle body.

Spawns winter and early spring, usually at night. Eggs heavy, sticky, to $\frac{1}{32}$ in.; hatch in 15 days at 39°F. and reach maturity as fish at third year. Young have eyes on opposite sides of body and swim like other fishes.

Occurs in salt and brackish waters in shallows from Labrador to Georgia, over sand or mud to depth of 120 ft. Food, shrimps, mollusks, fish. Excellent food fish for men and good sport for unambitious sportsmen of the seashore.

Order Acanthopteri. Family Sphyraenidae

Barracuda. *Sphyraena barracuda*

Length to 10 ft., but rarely over 5 ft. 75-85 scales in lateral line. Silvery, with dorsal, anal, and ventral fins mostly black. Line record, 103½ lb., 5½ ft., 1932.

Fins of young nearly plain. Little known of breeding habits but assumed that breeding is in open sea. Food, fishes and almost any other animals it is able to find and to overpower. Fighter.

Typical in West Indies but found from Massachusetts to South Carolina as a menace to bathers and source of anglers' sport. Good food fish. Dangerous. Known from Eocene in fossil form.

Order Acanthopteri. Family Scombridae

Mackerel. *Scomber scombrus*

Length to 2 ft. Dark-blue above and plain silvery beneath, with about 30 dark wavy stripes. Lateral line wavy. Air bladder small or absent. A row of finlets behind dorsal fin. 2 Atlantic Coast species, mackerel and chub, not easily distinguished.

Spawns May-June. Eggs $\frac{1}{20}$ in., buoyant, not sticky; 540,000 to 18-oz. fish; hatch in 5 days at 56°F. After larval stage, young reach $\frac{1}{8}$ in. in 40 days, 2 in. in 3 months. About 3 out of 1 million survive 3 months. Spawn at 2 years, or 1 lb., or 1 ft. Maximum to 3½ lb.

In North Atlantic, from Norway to Labrador, south to Spain and Cape Hatteras, with related species over most oceans. Lacks keel found at tail base in related tunny. About 40 million lb. harvested on Atlantic Coast in 1940, as against 80 million lb. of Pacific and horse mackerel in West.

Order Acanthopteri. Family Thunnidae

Tuna. *Thunnus thynnus*

Length to 14 ft. Weight to 1,600 lb. Dark steel-blue above, silvery beneath, with yellow on some fins. Sides green tinted and pink, iridescent. Body covered with small scales. Related to bonito and albacore.

Spawns in schools, April-June. Eggs small, buoyant; hatch in 2 days to $\frac{1}{4}$ -in. larvae. In 3 months reach 1 lb. Probably matures at 3 years with weight of 33 lb. Much yet unknown. Feeds on other fish, mostly mackerel.

In Atlantic, Pacific, and Mediterranean. Particularly abundant off California coast. Caught by lines and nets and supports enormous industry. Average annual world yield about 675 million lb. Japan formerly harvested 68% of crop.

Order Acanthopteri. Family Pomotomidae

Bluefish. *Pomotomus saltatrix*

Length to 45 in. Weight to 27 lb. with world record of 50 lb. Related to pompanos. Like sea bass inside, mackerel outside.

Spawns in spring and early summer but eggs and larvae are apparently unknown. Food essentially fishes, squids, and similar marine animals. Estimated daily kill of 10 fish.

Excellent food and sport fish but highly destructive to other species. Atlantic and Indian Oceans. Not known north of Penobscot Bay. Unlike California bluefish.

Order Acanthopteri. Family Centrarchidae

Small-mouthed Black Bass. *Micropterus dolomieu*

Length to 2 ft.; at 5 months, 2-3 in.; 1 year, 4-5 in.; 2 years, 6-8 in. Rear of upper jaw does not extend to rear margin of eye. Weight to 7 lb. 17 rows of scales on cheek and 72-75 scales in lateral line; 11, lateral line to base of dorsal fin.

Male builds nest on pond bottom May-July. Female at 62°F. adds about 7,000 eggs for each pound of her weight. Eggs guarded by male. Young guarded, without black lateral stripe of large-mouthed bass but with conspicuous black band across tail. Line record, 14 lb., 28 in., 1932, Oakland, Fla.

A most popular fresh-water game fish of cool lakes and streams from Lake Champlain to Manitoba, south to South Carolina and Arkansas, and widely introduced elsewhere. Possibly most exciting fighter, pound for pound, of any fish. Cannot survive 100°F. in water. Feeds best at 60-70°F., favoring 67°F.

Large-mouthed Black Bass. *Micropterus salmoides*

Length to nearly 3 ft. In adults rear of jaw extends beyond rear of eye. Dorsal fin, almost divided. Rows of cheek scales, 10. Scales of lateral line, to 68; 7, lateral line to base of dorsal fin. Anal spines, 3.

Male builds nest on lake bottom, fanning silt away. Eggs laid at 62°F. in nest. Nest and young protected by male. Young with broad black stripe on side. When hooked, does not ordinarily jump so readily as does small-mouthed bass. Feeds best at 65-73°F., evening or morning.

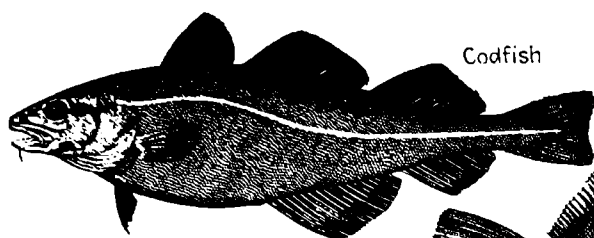
Important game fish in southern waters where it is known as "trout." Lends itself readily to pond but not to rough culture. Quebec to Florida and west to Mexico and Manitoba. Introduced elsewhere extensively. Line record, 22¼ lb.

Sunfish, Pumpkin Seed, Bream. *Lepomis gibbosus*

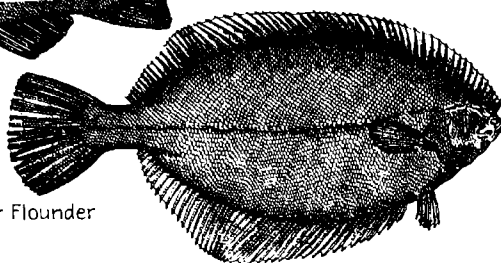
Length, 5 months, 2-2½ in.; 1 year, 3-4 in.; 2 years, 5-6 in. Maximum 8 in. Spines on anal fin, 3 as in warmouth but there are no teeth on sunfish tongues. Brilliant green to olive, with orange belly and spots on sides.

Male builds nest commonly among weeds at water temperature of 68°F. Nest about 1 ft. across, hollowed, root-lined or gravel-based. Eggs and young protected vigorously by male who uses many females in his nest. Food, any small animals such as insects, worms, fish, and crayfish.

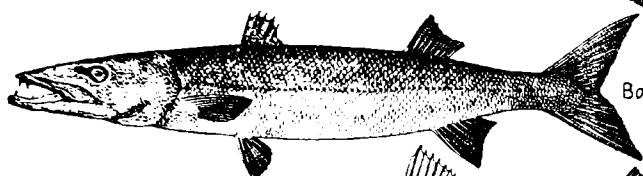
Ideal fish for small boys and excellent pan fish. Common in ponds and streams with sand, mud, and vegetation on bottom. Maine to Minnesota south to Florida and Mississippi Valley but more common in South. An excellent fighter for its size.



Codfish

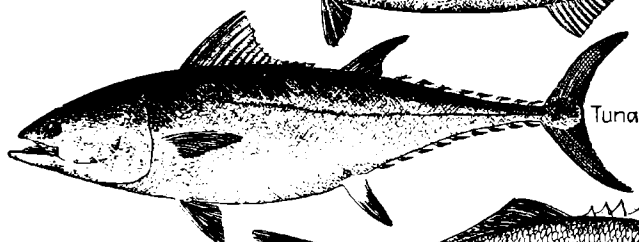
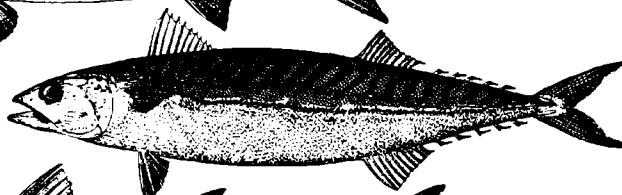


Winter Flounder



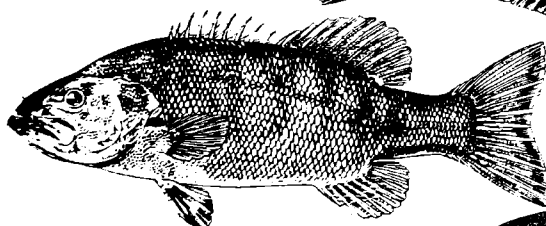
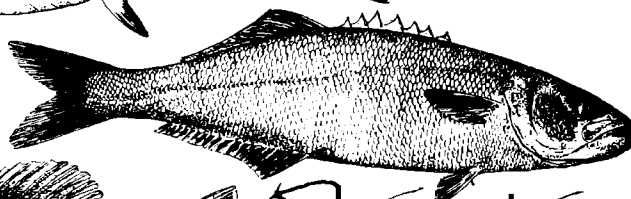
Barracuda

Mackerel

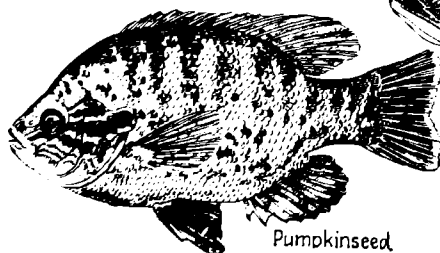


Tuna

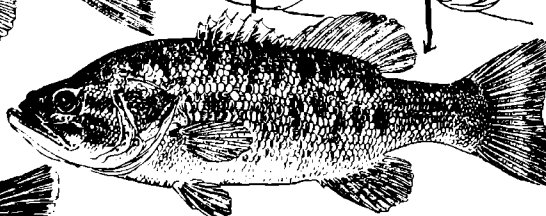
Bluefish



Small-mouthed Black Bass



Pumpkinseed



Large-mouthed Black Bass

PHYLUM CHORDATA. SUPERCLASS PISCES. CLASS TELEOSTEI

Order Acanthopteri. Family Centrarchidae

Rock Bass. *Ambloplites rupestris*

Length, 5 months, 1-1½ in.; 1 year, 1½-2½ in.; 2 years, 3-4 in. Maximum 12 in. Anal spine, 5-8 but usually 6. Dorsal spines, 11. Gill rakers, less than 10. Contrast with Sacramento perch, *Archoplites*, with 20 gill rakers and 12-13 dorsal spines; and warmouth *Chaenobrytus*, 3 anal, 10 dorsal spines.

Breeds in early summer, in water about 74°F. Eggs placed in nests prepared and defended by male, often in deeper water than associated sunfish. Bites vigorously and fights valiantly. Food, other fish, crayfish, worms, and other animals it is able to overcome.

Excellent pan fish, generally popular and abundant in lakes and slow rivers, from Vermont to Manitoba south to Alabama, Louisiana, and Texas, being most common west of Alleghenies. Related Sacramento perch in Sacramento and San Joaquin rivers. Related warmouth at best in South.

Crappie

(1) white crappie, *Pomoxis annularis*. (2) black crappie, calico bass, *P. nigro maculatus* (illustrated). Length to 1 ft. Anal fins nearly as long as dorsal. Dorsal spines of (1), 5 or normally 6; of (2), 7-8. (2) is deeper and generally darker than (1).

Spawns in early summer in rather deep water over gravel in separate nest, not easily observable. Incubation a few days to 2 weeks or more. Eggs likely to be injured below 58°F. or destroyed below 55°F.

Both are popular, readily biting pan fish. Found in pools and slow streams from Texas to Alabama, north to Vermont and Dakotas. Feeds commonly on aquatic insects and kin. Popular in farm fish ponds which are now becoming common.

Order Acanthopteri. Family Percidae

Johnny Darter. *Boleosoma nigrum*

Length to over 3 in., rarely. Body slender. Scales relatively large. Sides with numerous W-shaped dark blotches. Cheeks and breast usually scaleless. Many close relatives.

Males in spring black in forward regions or all over. Most darters attach eggs in May-June to undersides of stones or boards in relatively quiet water, some making excavation for this purpose. Bottom feeders.

From Colorado to Quebec, through southern Canada and Dakota south to Oklahoma, Missouri, and western Pennsylvania, usually in relatively quiet streams, usually but not always over gravel or in weeds.

Yellow Perch. *Perca flavescens*

Length, 5 months, 2-2½ in.; 1 year, 3-4 in.; 2 years, 5-6 in. Maximum 12 in. Weight to 4 lb. 3 oz. Yellowish, with dark-green vertical bands. Scales moderate. Skin tough. Flesh excellent. Body cavity relatively small.

Males in early spring pair with females, who swim through weeds laying ¼-in. eggs in zigzag ribbons sometimes to 7 ft. long. A 24-oz. fish may yield 41 oz. of eggs. Food, small animals such as worms, crayfish, and minnows. Line record, 4¼ lb., 1865, Bordentown, N. J.

A superior and popular food and game fish hook on hook, either with bait or fly, and in nets commercially. Found in lakes and streams over muddy bottom, in little current, from Nova Scotia to Dakotas, south to Ohio, with related species in Europe and Asia.

Yellow Pike Perch, Walleyed Pike, Doré. *Stizostedion vitreum*

Length, 5 months, 5-7 in.; 1 year, 8-12 in.; 2 years, 12-15 in. Maximum to 36 in. Weight to 25 lb. Cheeks and gill covers sparsely scaled, as distinguished from sauger or sand pike *S. canadense*, in which they are fully scaled. Dark olive with dark blotches. Pink belly.

Mates April-May. A 2-lb. fish lays about 45,000 eggs per lb. Eggs ⅓ in.; hatch in 2 weeks. No parental care. Species lends itself well to hatchery conditions. Become sexually mature at 12-13 in. in third year, or end of second. Sauger lengths first 4 years are 4, 8, 11, and 12½ in., with maturity at 13 in. Line record, 22½ lb.

Found in lakes and large rivers from Hudson Bay and upper Mackenzie, south through Vermont, Pennsylvania, and Georgia, west to Alberta. Most abundant in Great Lakes where 6 million lb. is annual crop, in addition to 8 million from Canada. 13 million lb. of sauger, annual Canadian yield and 6 million lb. of blue pike. Known as "jack salmon." Feeds well at 55-70°F.

Order Acanthopteri. Family Serranidae

Striped Bass. *Roccus saxatilis*

Length to 5½ ft. Weight to 125 lb. Anal fins with 3 spines and 12 soft rays. Dorsal fins, 2. Sides with longitudinal dark stripes. Related white perch has 3 anal spines, 9 soft rays; sides plain dusky silver, or longitudinally striped. Line record, 73 lb., 5 ft., 1913.

Marine species that ascends rivers and bays to spawn in May. Eggs not sticky, ⅓ in., sink slowly in fresh water; hatch in 3 days at 58°F., a large female laying over 2,200,000; may drift with tide and current while incubating. Females mature at 4 years, 20 in.; males, at 2 years, 12 in.

Gulf of St. Lawrence to Florida, being most common between Cape Cod and Cape May. Successfully introduced on Pacific Coast. A justly popular food and game fish. Weight increase first year: 4 in., 1 oz.; second year: ½ lb.; fourth year: 2½ lb.; eighth year: 12 lb. Weakfish a relative.

Order Acanthopteri. Family Cichlidae

Angelfish, Scalare. *Pterophyllum scalare*

Length to 8 in. Bright silvery, with broad dark vertical bands that may disappear if fish is not among plants. So thin it can hide behind a slender plant stem. Nocturnal. Nervous, often injuring self seriously by dashing against sides of tank.

Particular in choosing mates. Breeds at water temperature of 75-85°F. Eggs laid in rows on strong-stemmed plants. In aquariums, eggs should be removed for protection against parent. In mouthbreeder *Haplochromis*, eggs are incubated and young protected several weeks in female's mouth. In *Tilapia*, male performs this duty.

Native of Amazon. Introduced into Germany in 1909 as aquarium fish, pairs selling in Europe in 1911 to \$100. Now so abundant they are available to anyone. Most relatives in family are food fishes of considerable value and take hook readily. Related aquarium fish include *Cichlasoma*, *Etroplus*, and others.

Order Cataphracti. Family Cottidae

Muddler, Sculpin, Blob, Millers' Thumb. *Cottus cognatus*

Length to about 6 in. Scaleless. Forefins (pectorals), large and fan-like. Head large and flattened. Anal and second dorsal fins large and conspicuous. Mouth large.

Eggs laid in orange-colored masses under stones in cold streams and lakes. *Cottus* always nests in fresh water though there are related marine genera. Particularly destructive to nests and eggs of trout in some places.

Ranges from Alaska south to Virginia and westward through Great Lakes area to Iowa, with subspecies extending range to Alabama and elsewhere. Found commonly in cold lakes and streams.

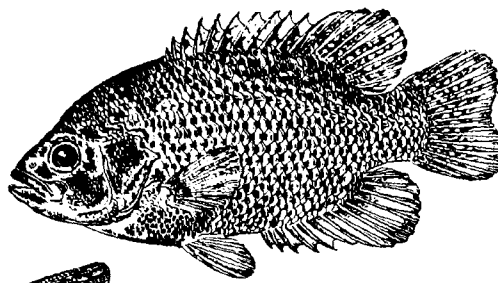
Order Plectognathi. Family Diodontidae

Spiny Boxfish, Burfish, Swelltoad. *Cyclichthys schoepfi*

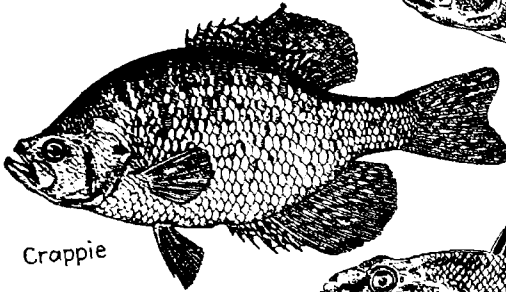
Length to 10 in. Spines immovable, unlike movable spines of porcupine fish, which reaches a length of to 3 ft.

These and related swellfish can inflate selves prodigiously when disturbed. Spines of porcupine fish can inflict dangerous wounds. Young hatched from eggs laid in summer; do not resemble parents until at least ¼ in. long.

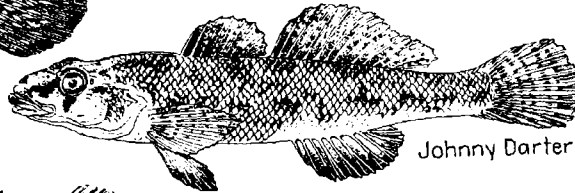
Spiny boxfish illustrated is found in sea from Cape Cod to West Indies. Does not inflate so readily as some other species. Some relatives were used as armor by primitive peoples. Skins sold as curiosities; some used as Japanese lanterns.



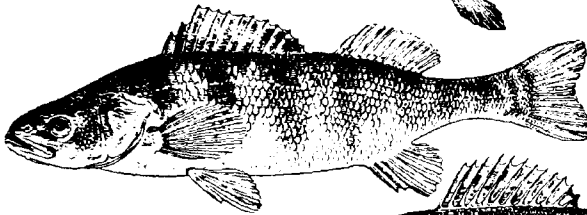
Rock Bass



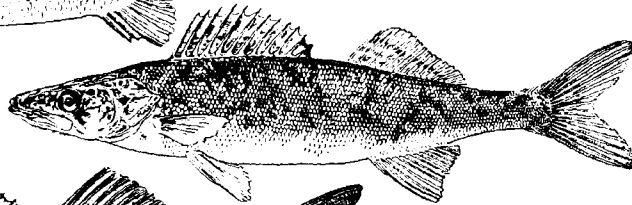
Crappie



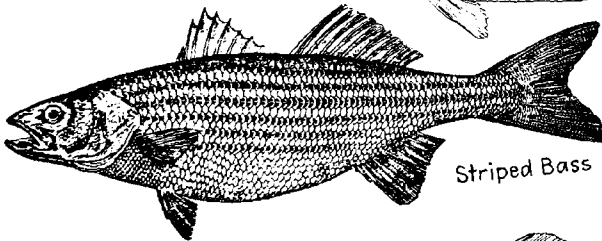
Johnny Darter



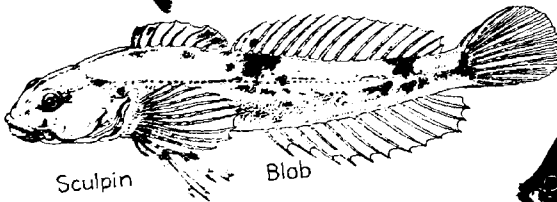
Yellow Perch



Pike Perch
Wall-eyed Pike

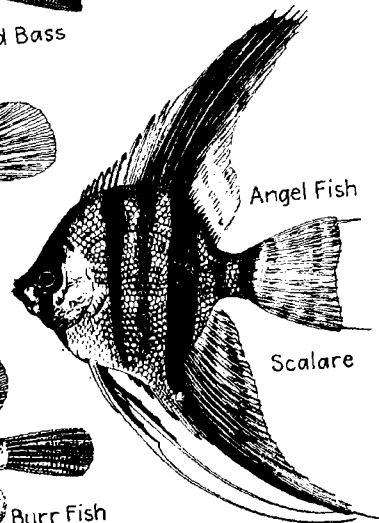


Striped Bass



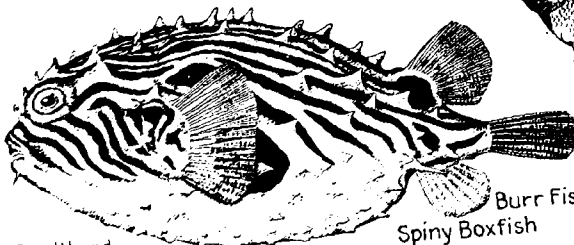
Sculpin

Blob



Angel Fish

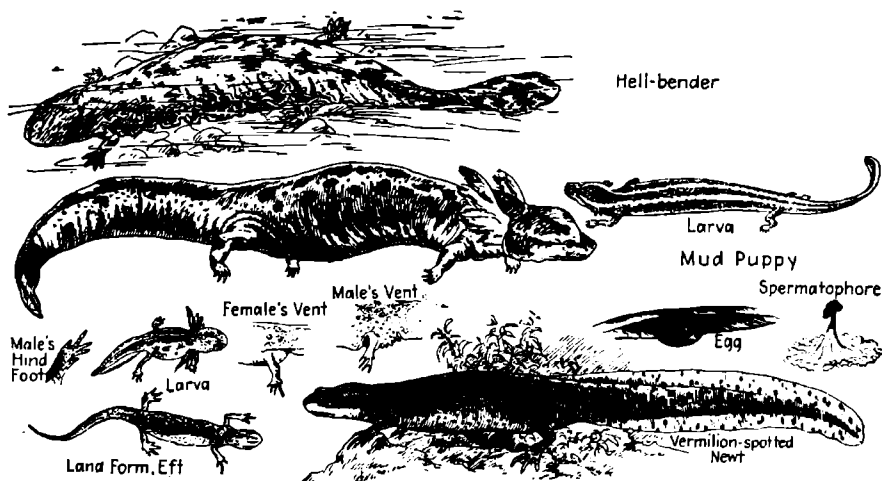
Scalare



Burr Fish

Spiny Boxfish

Swelitoad



PHYLUM CHORDATA. CLASS AMPHIBIA

Order Caudata

Family Proteidae

Mud Puppy, Water Dog

Necturus maculosus

Length to 18 in., though more commonly about 1 ft. With 4 short legs and weak 4-toed feet, a strongly flattened tail that acts as a fin, and a head flattened at right angles to tail. Behind head, on either side, are 3 tufts of fluffy red gills. Color dark-brown, gray-brown, or black, usually with spots and mottlings. Slimy.

In rivers and quiet streams of fresh water, at depths of 4-8 ft., usually among water weeds. Commonest in eastern United States, north and west of the Alleghenies, particularly in Great Lakes, Mississippi, and Hudson River drainage systems and south to Georgia and Alabama. 2 species in genus; a closely related genus is *Proteus* of Austria.

Mate in autumn. In spring, eggs resembling light yellow spheres to $\frac{1}{4}$ in. through are laid on individual jelly stalks under stones or logs or in sunlit sand nest, a female laying to over 140 eggs and protecting them until in 6-9 weeks they hatch into $\frac{3}{4}$ -in. larvae, which in 10 weeks reach length of $1\frac{1}{2}$ in. and become mature in 7-8 years at length of 7-8 in.

Food includes fish eggs, worms, insects and their larvae, and any other aquatic animals that may be found while animals prowling about the bottom, usually at night. Movements may be slow but bite may be vigorous and action may take place throughout year. Usually is hidden quietly in daytime but begins roaming as darkness approaches. Slime serves as some protection from enemies.

Reported to be good to eat. Feared by some persons as poisonous though there is no basis for this belief. Thought by others to be serious enemies of fish though authorities do not consider this important. Biological supply houses need the animals for classes in animal anatomy, one firm alone supplying over 2,000 a year. Animals probably live for at least 23 years.

Family Cryptobranchidae

Hellbender

Cryptobranchus alleganiensis

Length to over 2 ft. but usually about 18 in. Head broad, flattened, and without gill ruffle of mud puppy. Legs 4, but of little use since animal swims mostly by flexing body and tail. Skin appears greatly wrinkled and too large for animal. Gills internal. Dark-brown to black. Tail of female, $\frac{1}{2}$ length.

In rivers and streams in eastern United States, particularly in Lake Erie, the Ohio Valley, and rivers that flow from Allegheny highlands, south to Louisiana and Georgia. 2 genera of closely related giant salamanders are *Megalobatrachus* of China and Japan, and *Cryptobranchus* of our region. Fossil forms existed 250 million years ago.

Male courts female, though many individuals may crowd together before real mating begins in fall. Male builds hollowed nest under rock and induces females to lay eggs in it. One nest may contain nearly 2,000 eggs, which appear like tangled strings of beads. Male adds milt to new eggs, eats a few, and protects them 10 days to 2 weeks until they hatch. Eggs may take to 3 months to hatch.

Food, mostly crayfish and other aquatic animals found while prowling over bottom. Normally larvae are over $2\frac{1}{2}$ in. long in 9 months, with external gills. At 1 year, gills are reduced and legs developed. At 2 years, gills have been absorbed or partly so and length may be 6 in. Matures at 1 ft. in 3-4 years.

Flesh known to be good food but probably is rarely eaten. It is not poisonous in any way. Japanese eat their giant salamander, which reaches a length of 5 ft. and lays eggs the size of grapes. Blood in a stream may attract native hellbenders, the animals coming in considerable numbers to the source.

Family Salamandridae

Newt, Eft

Triturus viridescens

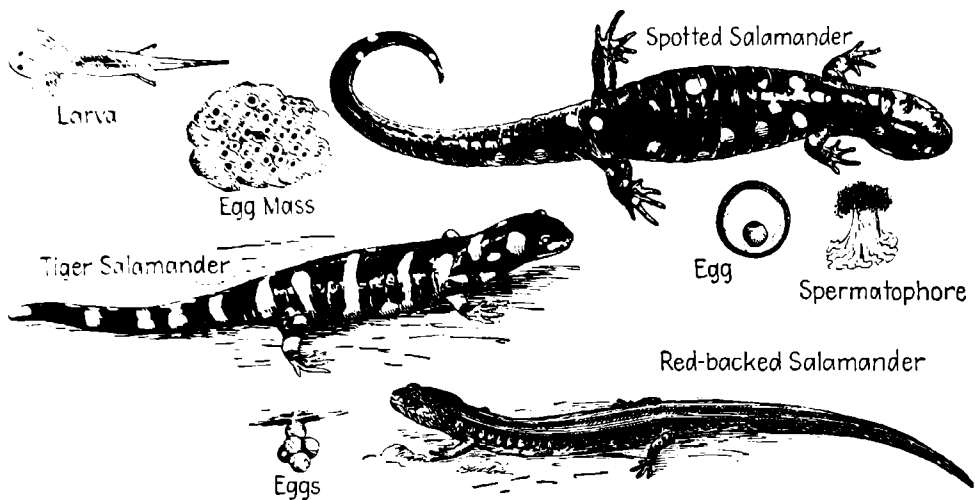
Average length 3-4 in., male being slightly the larger. Adult brown, with yellowish under parts and red and black spots. Tail fin-like and most conspicuous in breeding male. Male with black swellings on inside surfaces of thighs and feet and swollen vent more developed than in female. Red land form, immature and lacking fin on tail, is called "eft."

Found in fresh water or on land throughout year. Red eft is found among moist plant growth while adult and early larval stages are spent in water. Genus includes giant newt *T. torosus* of humid California, Oregon, and Washington, and *T. viridescens*, common newt of eastern North America from Hudson Bay to Texas and west to Illinois, Michigan, Missouri, and Oklahoma.

After courtship in fall, winter, or spring, male in spring deposits a jelly spermatophore, which female collects. Female may lay over 100 eggs singly on submerged support. Incubation of 20-35 days, or shorter at room temperature, brings hatching into gilled larvae that in 3 months reach 1-in. length and absorb gills. Leave water for 1-3 years on land.

Food, almost any small animal life. May haunt mass of hatching frog eggs, snapping up young as they emerge, or may destroy great numbers of mosquito larvae and pupae. In some areas, red eft land stage is omitted and its length may vary regionally or among those of a single locality. Adult form and its return to continued aquatic life may start in fall or spring.

Animals may be considered as enemies of frogs and of fish nests but also of mosquitoes. Efts have gained a reputation for mysterious habits associated with pixies and fairies, but this only makes them more interesting without helping understand them. In aquariums they may be fed ground beef on a dangling thread or toothpick. Blood of some forms bears microscopic trypanosomes. Known to live to 7 years.



PHYLUM CHORDATA. CLASS AMPHIBIA
Order Caudata

Family Ambystomidae

Tiger Salamander

Ambystoma tigrinum

Length to 10 in. Males average 8 in., females 7 in. Stout, broad-headed, with a distinct neck. Adult without external gills and without groove from nostril to lip. Basic color deep brown to black. Marked with pale irregular yellow-brown or olive blotches that form bands beneath and sometimes on tail. Breeding males have swollen vent.

Burrows in soft ground during most of season but comes to shallow ponds to breed. Ranges from New York and Connecticut down Atlantic side of Appalachians to Florida and up west side to Ohio, west to Arizona, Utah, Idaho, Oregon, and Washington and along southern part of Canada, being subdivided in the range into 5 subspecies.

From January-March, depending on territory, migrate to breeding ground. After courtship and spermatophore production by male, female may lay to over 100 3-enveloped eggs in kidney-shaped jelly mass to size of 3 by 4 in. attached below water. Hatch in 3-4 weeks into $\frac{3}{4}$ -in. larvae, which in 75-115 days transform into animals that may breed following spring.

Food essentially small animals caught while prowling at night or burrowing in loose soil. In captivity, may eat small frogs. In some parts of western United States and in lakes around Mexico City, tiger salamanders may retain gills and aquatic habit and breed as "permanent larvae." Possibly because of burrowing habit, can survive where others disappear.

Economic importance about same as for spotted salamander and probably negligible. May be popular for sale as terrarium pets as they are hardy and interesting-looking. Interesting to biologists because some retain gills in adult state, this larval form being spoken of as the *axolotl*. Apparently entirely harmless to man.

Spotted Salamander

Ambystoma maculatum

Length to $7\frac{3}{4}$ in., of which tail is about half. Females, rarely over 7 in. long, have lighter colored bellies than males and lack swollen vents of males. Greenish- or brownish-black, with bright yellow round dots, shining, moist, and, when badly disturbed, mucus-covered. Several enlarged pores on head. No external gills in adult.

Adults commonly found in woodlands or sometimes in meadows where there are near-by marshes or waterways. Sometimes found in cellars. Ranges from lower part of mouth of St. Lawrence River to Florida, west to eastern Texas, Oklahoma, Missouri, Illinois, Wisconsin, and Lake Superior region, and east through southern Canada except for a few areas.

In early spring, both sexes migrate to a shallow pool. After a courtship, male lays a jelly spermatophore, which female takes up. She then lays a mass of eggs, which within 1 hour may be to 4 in. through and contain some 200 eggs, each in 2 jelly coats. Eggs hatch in 2-4 weeks into $\frac{1}{2}$ -in. larvae, which in 3 months may become 3 in. long before transforming to adult stage.

Food, largely insects, slugs, snails, and worms. Larvae do best in temperature of about 65°F. In first year after transformation, animals reach a length of over 3 in. Known to live for at least 24 years where there is ample protection. Spotted salamanders are less likely to winter in groups than are Jefferson's salamanders.

While many persons feel that these animals are poisonous and should be destroyed, there is no basis for this opinion. Ernest Thompson Seton in his story of the kangaroo rats displays a wholly unjustified prejudice against this animal, which he falsely classifies as a reptile, so it is not surprising that laymen generally try to destroy what they consider "poisonous lizards."

Family Plethodontidae

Red-backed Salamander

Plethodon cinereus

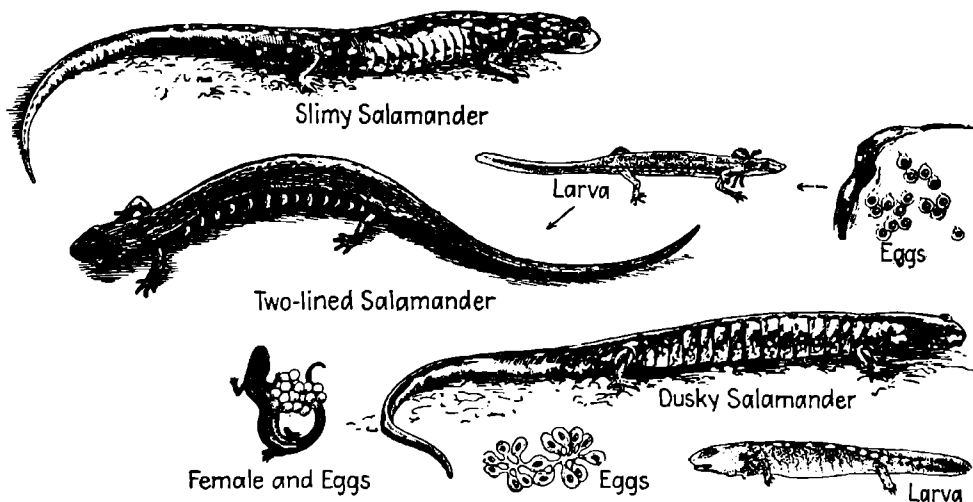
Length to 5 in. Male usually smaller than female. Body slender and relatively long. No light bar from eye to corner of mouth. Resembles slimy salamander but has 18 or more vertical grooves on sides while slimy salamander has fewer than 16 between front and hind legs. Variable in color, some being all red, others with red or gray back stripe.

Found in drier places than dusky salamander but otherwise similar. Usually in old stumps or logs, under leaves or bark, in moss, or in almost any kind of woodland trash. Ranges from Gulf of St. Lawrence to Georgia and Alabama, west to Oklahoma, Illinois, Minnesota, and southern Canada to James Bay, with at least 2 subspecies represented.

Sexes mate in fall. Following spring, female lays about 12 eggs to $\frac{3}{8}$ in. through, in 3 jelly coats, usually under wet wood and protected by mother. Larval stage is passed in egg, the young having gills only a short time after hatching. Young 1 in. long when hatched, soon independent of parent. In 2 years, may breed at $1\frac{1}{2}$ in.

Food, insects and other small animals, frequently captured by a swift forward thrust of tongue, which can be accurately directed. Can secrete a small amount of slime that might be considered a protection. Can be killed easily by being held too long in a warm dry hand. May shed tail if escape is essential, in which case a new tail without vertebrae develops.

This is an ideal schoolroom terrarium pet but only a few should be kept and those confined should be given sensible care. May be trained to feed on pieces of ground meat hung on end of a thread and swung back and forth before mouth.



PHYLUM CHORDATA. CLASS AMPHIBIA
Order Caudata. Family Plethodontidae

Slimy Salamander
Plethodon glutinosus

Length to $7\frac{1}{4}$ in. Smooth, slender, shining, dark violet-black to gray at tail, with gray undersides. Sometimes marked attractively in fore parts with pearly-white pin points. Feet pale brown. Front feet 4-toed, hind feet 5-toed. All feet lack large glands beneath. Skin oozes milky slime when touched.

Commonest in shady ravines or caves or under logs, stones, and trash except that during or after rain animals may come out and move about actively. Ranges from eastern Canada through New England to Florida and west to Wisconsin, Missouri, Texas, and the Gulf, with some 20 species and subspecies in United States.

Little is known of reproductive habits. Male has a small circular white mark at rear of lower margin of lower jaw. It is assumed that mating takes place in fall, that eggs are laid in winter or early spring. Eggs are found in crevices in caves, in clusters, with or without female near by. Eggs are white and to $\frac{1}{4}$ in. through.

Food about half insects and the remainder sow bugs, worms, millipeds, centipedes, and the like. Deliberate in movement but may move rapidly, as its legs are strong enough to lift body from ground. Lives its whole life on land, young emerging from egg well-developed and to $\frac{1}{2}$ in. long.

Makes an interesting pet in a terrarium though it may burrow deeply during day. Slime undoubtedly protects it from its enemies, among which is short-tailed shrew. Nocturnal.

Two-lined Salamander
Eurycea bislineata

Length to nearly 4 in. Tongue free at front margin but attached at center beneath. No line from eye to nostril such as is found in purple salamander. Slender, pale straw-colored, with narrow dark line running down each side from eye onto tail. Belly yellow. Sides dotted. Tail somewhat flattened and thus unlike dusky salamander.

Found almost exclusively along edges of fresh-water small streams, under stones or logs and in shallow water. Ranges from New England to Florida west to Louisiana, north to Lake Superior, and through southern Canada. 9 closely related species within much the same range and with rather minor differences.

After an elaborate courtship, usually in fall, male deposits a spermatophore, which female takes up. In spring, eggs are laid under rocks under water in current. Female may lay about 30 eggs $\frac{1}{8}$ in. in diameter, which hatch in about 10 weeks into $\frac{1}{2}$ -in. yellow slender larvae that reach length of 2 in. in 2 years and transform into adults.

Food, small aquatic animals such as insects, worms, spiders, crustacea, and the like, caught by foraging in daylight more commonly than is customary in most salamanders. In some parts of country, winter is spent on land in a burrow under trash; in other parts it may be spent in an active state in deeper water than that haunted in summer months.

Probably is of little direct economic importance to man. It may serve as a minor check on multiplication of some aquatic animals and as food for larger animals. This salamander is very active in summer and leaps from one's hand to escape, sometimes leaving tail behind. Animals do not thrive in aquariums unless water is kept fresh and active.

Dusky Salamander
Desmognathus fuscus

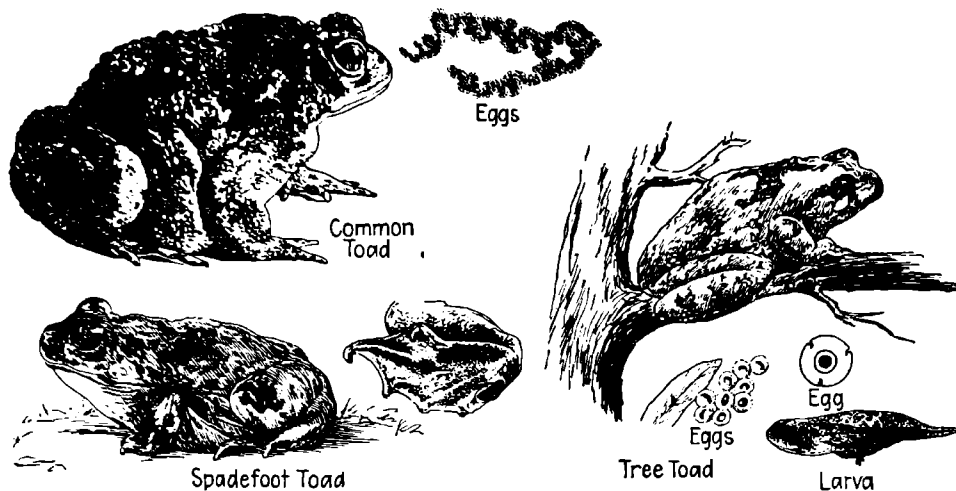
Length to $4\frac{1}{2}$ in. With a light line running from eye to mouth. Tail more or less triangular in cross section. Tongue attached at forward margin. Body rather short and tail rather long. Back blackish or yellow-brown, usually uniform but sometimes with black-edged blotches or broad black-edged backband. Sides usually without any small light dots.

Near springs where there is an accumulation of leaves or at the margins of springs or cool streams but usually not in water itself. Common in dried stream beds where there is a little water left. From New Brunswick to Florida and west to eastern Texas, eastern Oklahoma, southern Illinois, central Ohio, and just into Canada at Niagara region.

Males may court females fall or spring. Spermatophore may be deposited in female or picked up by her. Female lays 12-26 $\frac{1}{8}$ -in. 3-enveloped yellow-white eggs in bunches like grapes from June-September in wet area under moss or refuse. Female protects eggs until in 2 months they hatch into $\frac{1}{2}$ -in. larvae, which live in water 8-10 months, transforming into 1-in. adults which mature at 2 years and 2 in.

Mostly nocturnal. Food essentially earthworms, snails, slugs, spiders, insects, and some vegetable matter. Larvae that hatch on the ground must make their way by minute trickles of water to a water supply to continue development. Dusky salamanders are known to have been eaten by purple salamanders and probably have many other animal enemies such as raccoons.

Dusky salamanders known to eat insects that have fed on sewage; have been known to act as reservoirs for colon bacilli actively enough to contaminate 237 gal. of water in 122 days. Doubtful if record against this species is any worse than that for other salamanders whose habits have not been so carefully studied.



PHYLUM CHORDATA. CLASS AMPHIBIA
Order Salientia

Family Scaphiopodidae

Spadefoot Toad
Scaphiopus holbrookii

Length to 2 $\frac{3}{4}$ in. Body short and compact. Skin relatively smooth but with some scattered warts. Arms and legs stout. Belly gray. Throat and breast white in both sexes, thus differing from common toad. On inner sides of soles of hind feet are dark horny structures used in digging, which give toad its name. Pupils vertical.

Found over loose soil, into which it easily digs shallow burrows. Ranges from Massachusetts to Florida, west to Texas, Arkansas, and Indiana. In United States, at least 3 species and a total of 7 subspecies, whose combined range covers entire country and some of southern Canada and northern Mexico, with of course a few exceptions.

In spring, females meet broad-fingered males in a pond where they are calling. Breeding, carried on in heavy rainfall, may continue from January-September. Eggs laid in 2 days. In 14-60 days a 1-in. tadpole develops that in late summer transforms into $\frac{1}{2}$ -in. toad.

Food largely insects, worms, and other small animals caught by lightning-like thrust of tongue. Call of male is a repeated *uank*, quite different from that of common toad. Almost wholly nocturnal and therefore often missed in areas where it may be reasonably abundant. Burrows largely with assistance of horny area of feet.

Of course, this animal is useful as a destroyer of garden pests and is harmless both to man and to his pets. A rather sluggish animal and therefore possibly less interesting than some of its relatives. Ordinarily, other species and subspecies of spadefoots are smaller than one here considered.

Family Bufonidae

American Toad
Bufo americanus

Length to 5 $\frac{1}{2}$ in. but usually smaller. Female the larger, with male rarely over 3 $\frac{1}{2}$ in. Breeding male with black on throat and inner side of thumb. Fat. Skin roughened by pairs of dark spots on the back, each surrounding a wart, and with 2 large glands back of eyes and neck. Eyes prominent. Undersides finely roughened, with scattered dark spots.

Common in gardens and about lawns where there is damp soil and concealment. Ranges eastern North America to Great Bear Lake and Mexico, reaching elevation of 5,800 ft. in Tennessee, favoring higher areas where there is competition with Fowler's toad, whose dark spots on back enclose more than one wart. Range extended to Pacific Coast by 13 species.

In spring, males precede females to shallow breeding pond and begin prolonged trilling call, mostly during rainy weather. Female may lay to 15,000 black and white $\frac{1}{2}$ -in. eggs in paired jelly strings to 72 ft. long, weighing to 5 $\frac{1}{2}$ times weight of mother. Eggs hatch in 3-12 days into black tadpoles, transforming in 40-60 days into $\frac{3}{8}$ -in. toads that mature in 2-3 years.

Food, cutworms, potato beetles, chinch bugs, earthworms, ants, slugs, or almost any small animal that moves, captured by 2-in. thrust of sticky tongue, often after an interesting stalk. Can exude slime distasteful to many enemies but not poisonous to man, although giant toad of tropics may cause suffering or blindness to man or dogs. European toad may live to 36 years.

One of most useful animals associated with man and with his crops. One of best residents of any garden. In China, toad skin is used as a medicine, not unwisely since it contains adrenalin, which increases man's blood pressure. Cannot live for years confined in a rock nor does it cause warts on persons who may handle it. Spends winters buried to 3 ft. deep in loose soil.

Family Hylidae

Tree Toad
Hyla versicolor

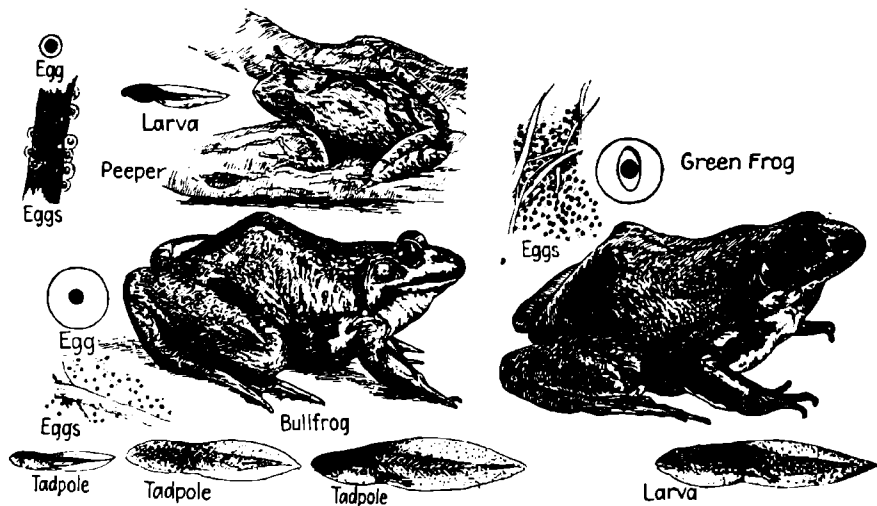
Length, male to 2 in.; female to 2 $\frac{3}{8}$ in. Legs slender. Toes end in sticky discs but in breeding season inner side of male's thumb bears a large pad. Skin finely pimpled. Back and legs marked with dark areas, commonly black-bordered. Often orange under hind parts. Throat of male, loose and dark; of female, whitish.

In or near marshy waterways in spring but in summer in treetops, often considerable distances from water. Closely related to peeper. About 11 species cover United States and extend into Mexico and southern British Columbia. This species from Maine to Gulf States and west to Texas, Arkansas, and into Minnesota.

Males precede females to shallow, plant-grown, quiet pond of permanent water in spring and sing either at night or on cloudy or rainy days. Eggs $\frac{1}{2}$ -in., brown and yellow, in one thin and one loose jelly coat, laid free, attached, or at water surface in films of 4-40, though individual may lay to 2,000. Hatch in 4-5 days into $\frac{1}{4}$ -in. tadpoles with red-orange tails and cream-white bellies; reach length of 2 in. in 45-65 days.

Food essentially insects caught by speedy dart of tongue. Larvae feed on oozes in pond. In North, a tree frog that transforms at $\frac{3}{8}$ in. is 1 in. long at 1 year, 1 $\frac{1}{2}$ in. long at 2 years, and 1 $\frac{3}{8}$ in. at 3 years, when it reaches breeding size. It can cling to a clean vertical glass. Call of males is a short melodious trill.

Entirely useful as a destroyer of insects. In terrarium, may be fed on meal worms or earthworms and may become real pets. May be heard on damp or rainy nights when temperature is over 60°F., even in summer. Has remarkable ability to change color from gray to brown to green in about 1 hour. Test this by putting one animal in a dark and one in a lighted bottle.



PHYLUM CHORDATA. CLASS AMPHIBIA
Order Salientia

Family Hylidae

Family Ranidae

Peepers
Hyla crucifer

Length to 1 $\frac{3}{8}$ in., with male rarely over 1 $\frac{1}{8}$ in. Male usually darker than female, yellow on groin and with brown or black throat, while female is white in throat region. Male has pad on inner side of thumb in breeding season. Toes of both sexes are expanded into distinct discs that stick to supports. Dark cross on back and legs with dark crossbands.

In spring, found in pools or near marshy spots either in water or perched on vegetation near or above it. In summer, may be found to 60 ft. or more up in tops of trees. May be heard in woodlands any month of the year. Ranges from New Brunswick to South Carolina and west to Louisiana, Arkansas, Kansas, and Manitoba. Closely related to tree toad and some 10 other species.

Male precedes female to breeding ground in spring. Calls vigorously. After mating, female lays 800-1,300 $\frac{1}{2}$ -in. cream and black or brown eggs, more or less separately, on support under water, taking a day or more to lay the set. Eggs hatch in 5-15 days and in 75-90 days develop into 1 $\frac{1}{2}$ -in. tadpoles with purple-black blotches and iridescent creamy bellies.

Food of adults, insects caught by lightning thrust of tongue; of tadpoles, ooze gleaned from submerged objects. The 1 $\frac{1}{2}$ -in. tadpole transforms in July into a $\frac{3}{8}$ -in. peeper, which leaves the water and spends 3-4 years before reaching sufficient maturity to breed. Throughout its life has many enemies, from fish and salamanders to birds and squirrels.

Essentially useful as a check on insects. A delightful animal for an aquarium but even more so free in the open. May be fed chopped earthworms if kept through winter in terrarium, where it does not hibernate as it might in nature. Peeping, by male only, may be heard 1 mile; reaches a height in rising temperature but may persist to 30°F. in falling temperatures.

Bullfrog
Rana catesbeiana

Length, male to 7 $\frac{1}{2}$ in.; female to 8 in. Hind legs may be over 10 in. long. Webs of hind feet extend to tips of toes. Back, green, without warts, with ridges running behind ears but not down side of back. Male has yellow throat in breeding season and "ears" almost twice as wide as distance between nostrils instead of about same distance.

Favors small lakes and ponds with little wave action where there is a mud bottom and a permanent plant border of some height. Lives in water throughout its life and does not roam fields. Ranges through most of North America east of Rocky Mountains. Introduced west of Rockies to Pacific region and in Japan.

Mates from February (South) to July (North). Eggs $\frac{3}{10}$ - $\frac{1}{2}$ in., in several 3-5-ft. surface films, usually attached, totaling to 20,000, black and white, in one thick coat of loose jelly; hatch in 4 days and in North develop in 2 years into 5 $\frac{1}{2}$ -in. tadpoles, with irregularly spotted tails and yellow, not iridescent bellies.

Food of tadpoles, oozes and aquatic plants and animals; of adults, insects, other frogs, fish, birds, and other animals. Tadpoles transform into 2-in. frogs that under best conditions may reach 3 $\frac{1}{2}$ in. in 1 year and 4 $\frac{1}{2}$ in. in 2 years, when it could presumably breed, although 2-3 more years may be required to reach length of 5 $\frac{1}{2}$ -6 in. Known to live at least 15 years.

Excellent scavenger. Legs bring to 1 cent a pair, which in North is from animal up to 5 or more years old. Advertisements of "frog farms," claiming a market for breeders at \$6.66 a pair, are questionable. 500,000 frogs, of which this species is an important part, are used in biological laboratories in America each year. Call is a resounding *jug-o-rum*.

Green Frog
Rana clamitans

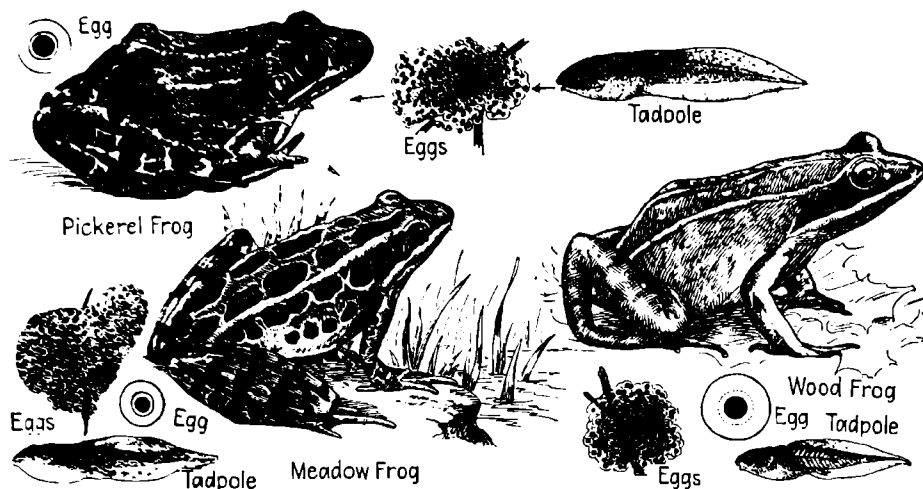
Length to 4 in. for female; to 3 $\frac{1}{2}$ in. for male. Male with "ear" larger than eye and with greenish-yellow spot in it, also with proportionately broader head. Both sexes have a pair of wrinkles running down back, one on either side, and toes less fully webbed than in bullfrog. Male has yellow throat in breeding season; female, white throat.

Lives in or within jumping distance of permanent pool, pond, or lake through its entire life. May hibernate in water or in a burrow above water line. Ranges through eastern North America from Canada to Florida. Introduced into state of Washington. In North Carolina is found to elevations of 4,200 ft.; in New Hampshire, to 2,230 ft.

When air temperatures have reached 65°F. in early summer, sexes mate. Females lay to 5,000 eggs in North and to 1,000 in South in a number of films to 1 ft. across, at water's surface. Eggs $\frac{1}{16}$ in. across, black and white; hatch in 3-5 days. Tadpoles develop in 370-400 days into 3 $\frac{1}{2}$ -in. tadpoles with green tails, brown spots, and creamy, not iridescent bellies.

Food of tadpoles, oozes and scums gleaned under water; of adults, almost any animal that can be captured. Mature tadpoles transform into 1 $\frac{1}{4}$ -in. frogs which in 1 year reach a length of 1 $\frac{1}{8}$ in., in 2 years 2 $\frac{1}{4}$ in., in 3 years 2 $\frac{1}{2}$ in., and in 4 years 3 $\frac{1}{2}$ in. May breed when they reach a length of 3 in. and have been known to live for 10 years.

Call is a pleasing *ichung*. These frogs are caught for their hind legs, which are edible but small. They make good laboratory animals and are protected by law during their breeding season in some states. For further information, see United States Bureau of Fisheries Document 888, "Frogs: Their Natural History and Utilization."



PHYLUM CHORDATA. CLASS AMPHIBIA
Order Salientia. Family Ranidae

Pickerel Frog, Spring Frog

Rana palustris

Length, male to 2 $\frac{3}{8}$ in.; female to 3 $\frac{3}{8}$ in. Some authorities claim that male is the larger. Male croaks, has swollen thumb at breeding time and small swellings between "ear" and arm. Much like leopard frog but has yellow under hind legs and rear part of belly, and dark spots on back are regularly in 2 rows, squarish, and black-bordered.

Common along streams, ponds, and lakes, sometimes wandering rather far from standing water during summer months but less inclined to do this than is meadow frog. Winters in marshes, ponds, and springs. Ranges Hudson Bay to Minnesota, Arkansas, Louisiana and to southeast, with closely related species extending range to west.

Breeds in North in April in great numbers, in ponds of permanent but relatively shallow water. Eggs brown and bright yellow, $\frac{1}{16}$ in., in a thin and a thick firm jelly coat in a globular free or attached underwater mass. Female may lay 2,000 eggs, which hatch in 6-19 days and develop in 70-90 days into 3-in. tadpoles with dark purple opaque tail crests and iridescent bellies.

Food of tadpoles, oozes and slimes of plant or animal material; of adults, insects, worms, and other small animals. Tadpoles transform into frogs that average 1 $\frac{1}{2}$ in. at end of 1 year, 1 $\frac{3}{4}$ in. at end of 2 years, 2 $\frac{1}{8}$ in. at end of 3 years, and 2 $\frac{3}{8}$ in. at end of 4 years, breeding size being reached at 2-3 years. Call a short, labored, unpleasant clacking grunt.

Legs sometimes used as food but are considered poisonous by some persons. Materials secreted by these frogs will kill other frogs closely confined with them. May irritate membranes of mouths of dogs rather severely. Protected by law in some states during breeding season and unquestionably more useful alive than dead. Will take a red-flannel-baited hook readily.

Meadow Frog, Leopard Frog

Rana pipiens

Length, male to 3 $\frac{1}{8}$ in.; female, to 4 $\frac{1}{10}$ in. Male with fold of skin over arms and sometimes with swollen thumb. Female without these characters. Skin smooth and generally moist. Green, with whitish-edged dark irregular blotches on back, commonly in more than 2 rows and with undersides of hind legs and rear of belly white instead of yellow-orange. Toes not webbed to tips.

Common in marshes and ponds in spring but in summer takes to open fields, cultivated lands, open grassy woodlands, meadows, and swamplands. Ranges from southern Canada south through most of North America east of Sierras and on into northern Mexico, with a number of closely related species extending range. One of frogs most commonly seen, since it is often on highways.

Breeds in North in April. Eggs $\frac{1}{16}$ in., black and white, in a thin and a thick firm jelly coat, laid under water and attached to some support but usually in long masses. Female may lay to 5,000 eggs, which hatch in 4-20 days and develop in 75-90 days into 3 $\frac{3}{8}$ -in. tadpoles, with high-crested translucent tails, fine markings, and creamy iridescent bellies.

Food of tadpoles, oozes and slimes on submerged objects; of adults, insects, worms, and other small animals. Tadpoles transform into 1-in. frogs which average 1 $\frac{1}{2}$ in. at end of 1 year, 2 in. at end of 2 years, 2 $\frac{1}{8}$ in. at end of 3 years, and 2 $\frac{3}{8}$ in. at end of 4 years, breeding size being reached at 3 years or sometimes earlier where season is long and conditions good.

Legs are used as food but animal is much more valuable alive than dead. Frogs younger than breeding age should never be killed; this species is protected by law in many states particularly in breeding season. Those collecting legs for market either shoot frogs or catch them by holding a fishhook baited with red flannel in front of them. Call is a short clacking grunt.

Wood Frog

Rana sylvatica

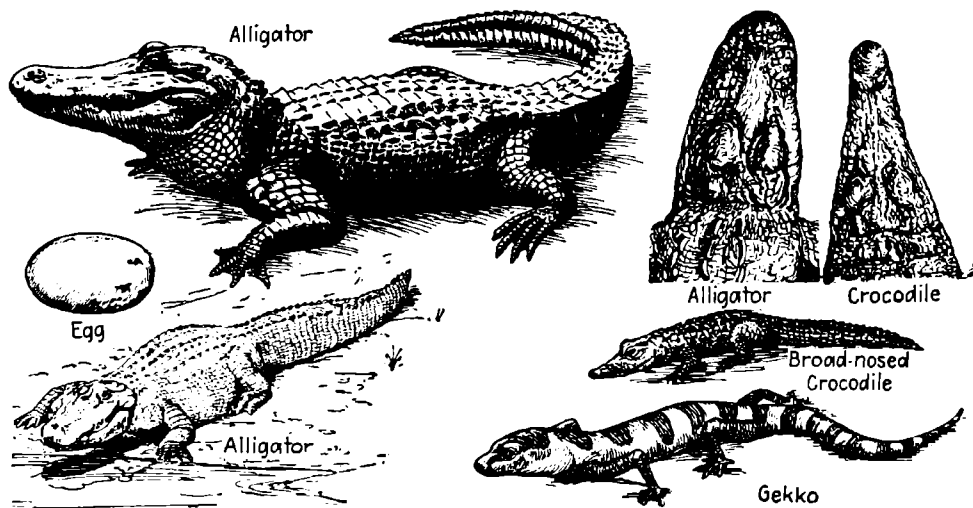
Length, male to 2 $\frac{1}{8}$ in.; female to 2 $\frac{3}{8}$ in. Easily recognized by black patch that lies behind eye, over "ear" and onto a point at base of forelimb. It lacks green and is predominantly brown of varying shades on back and sides. Skin lacks any conspicuous warts, toes are pointed, and legs are long and slender. Male croaks.

Found on the ground mostly in woodlands in summer, under stones, stumps, or litter in winter, and in woodland ponds in breeding season. Ranges from Nova Scotia to South Carolina, west to Arkansas and north except in western United States, southwestern Canada, and regions where soil is always frozen. A number of subspecies have been proposed or recognized.

Mates in April in North. Eggs $\frac{1}{10}$ - $\frac{1}{16}$ in., black and white, in 2 firm jelly coats, in several spheres, free or attached, under water, to 3,000; hatch in 4-24 days and develop in 44-85 days into 1 $\frac{1}{8}$ -in. tadpoles with creamy lines on their upper jaws, pink bellies, and iridescent bronze bellies. Tadpoles transform into $\frac{3}{8}$ -in. frogs that mature in to 4 years as described below.

Food of adults, small animals of forest floor; of tadpoles, oozes and slimes of breeding pond. Males in breeding season are darker than females, have swollen pads on inner side of thumb, and have webs of feet with convex rather than concave margins. Frogs are 1 in. long at 1 year, 1 $\frac{1}{8}$ in. at 2 years, 1 $\frac{3}{8}$ in. at 3 years, and 2 $\frac{1}{4}$ in. at 4 years.

Interesting animals that seem to leap from nowhere in the woodlands. In breeding season males give a confusing series of clacking croaks. Animals can change color remarkably in space of an hour and may be either dark or light, depending on their surroundings. May be of some value as destroyer of small animals and as food for larger ones.



PHYLUM CHORDATA. CLASS REPTILIA

Order Loricata Family Crocodylidae

Crocodiles, Caimans, Gavials *Crocodylus* sp. et al.

In crocodiles, the fourth tooth of lower jaw fits into notch in upper jaw when mouth is closed, while in alligators and caimans the fourth tooth fits into pit in upper jaw. Orinoco crocodiles have narrow heads while American crocodile (illustrated) has triangular snout. Gavials have extremely long slender snouts.

Indian gaviel may be to 30 ft. long, equaling Madagascar crocodile and exceeding largest 20-ft. caiman and largest 16-ft. alligator. Caimans are limited to tropical Americas; gavials, to India, Borneo, and Sumatra; but crocodiles are found in North America, South America, Australia, Africa, and Asia.

Young of all crocodilians are produced in eggs that are white, rather long and shining, with a thick hard shell. Eggs laid in a bank or in a nest of decaying plant material piled into a mound. Doubtful if reputed care of young by adults, particularly by male, has any basis in fact.

Crocodiles are vicious temperamental animals able to move rapidly on land and to strike with tail powerfully and accurately. Young feed usually on fish while adults prey on water birds or mammals that come to drink. In water of temperature of 45°F., crocodile is practically helpless.

Some crocodiles may be serious enemies of man, particularly salt-water crocodile *Crocodylus porosus* and African crocodile *C. niloticus*, which may pursue and capture humans in water or even on land. Crocodiles and alligators help keep waterways open and unintentionally help fish and man in various ways.

American Alligator *Alligator mississippiensis*

Length to 15 ft.; tail $\frac{1}{2}$ length. Weight to 500 lb. May mature at 9 ft. Snout broad, not pointed as in crocodiles, and fourth teeth do not show as they do in crocodiles. Teeth 19-20, on each side of each jaw. Skin roughened, leathery, and thick over most of body. Eyes and nostrils placed high. Male bellows and emits musk.

Ranges in rivers and swamps of lowlands of the Carolinas, Georgia, and Florida, west to Louisiana and Mississippi on to Rio Grande in Texas. American crocodile found in southern Florida, Greater Antilles except Puerto Rico, and both coasts of Central America from Mexico to Ecuador and Colombia.

Female lays 30-40 eggs, in nest of decaying plants, which aid in hatching; may protect nest. Eggs like long hen's eggs. Young when hatched, 8 in. long, weigh $1\frac{1}{2}$ oz. At 1 year, 18 in., 9 oz.; at 2 years, 23 in., 3 lb.; at $2\frac{1}{2}$ years, 45 in., 14 lb.; at 5 years, 66 in., 50 lb.

Food, animals captured in jaws or knocked down by thrashing tail. Can move head and tail sideways with great force and speed. Prey may be held under water until it drowns, then brought to surface and swallowed whole above water. 10-ft. alligator can swallow ducks whole. May "boom" when capturing food.

Hide valuable as source of leather but supply has been unwisely exhausted. Enemy of ducks and other water animals but avoids man when possible and normally would not harm him. Should be protected against extermination. Cannot survive low temperatures. May hibernate and aestivate 2 or more months each year.

Banded Gecko *Coleonyx variegatus*

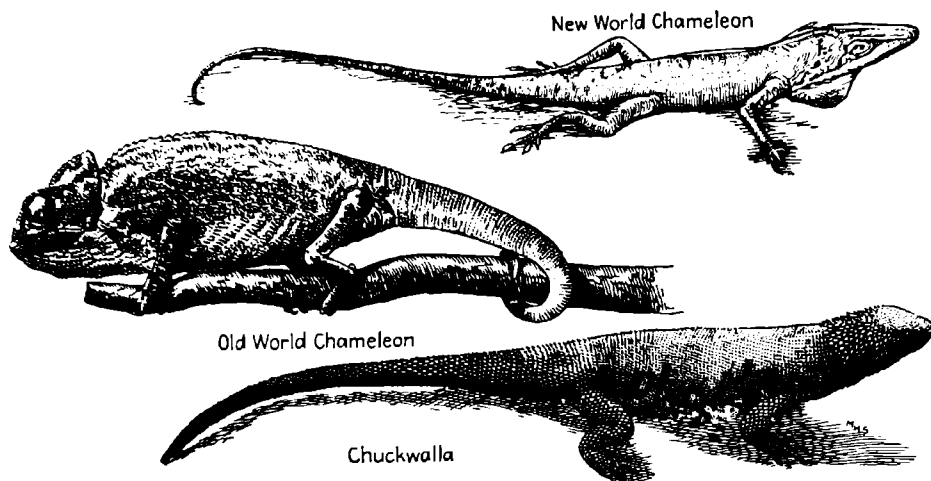
Length to about 4 in. Toes with suction discs useful in holding animal to smooth surface. Head only slightly wider than body. Tail approximately $\frac{1}{2}$ total length. Basic color brown but usually with conspicuous bright broad lemon-yellow bands crossing body and tail. Sometimes speckled rather than beaded as above.

This is one of 2 North American species of the genus, found in southwestern United States from Texas to California. Of some 300 species, most of which are tropical and of different genera, only about 6 are to be found native of North America. One species from Malay Peninsula reaches a length of 15 in. and is proportionately large.

Males generally larger than female geckos. Females lay several white hard-shelled rounded or bluntly oval eggs where they may hatch independent of parental care. Young resemble adults in general appearance and behavior. Animals are capable of making sounds something like gecko or similar to those produced by some katydid-like insects. May chorus.

Food, living, moving insects captured by a lightning-like thrust of long sticky tongue with swollen tip. Geckos apparently run with ease over ceilings and walls, coming out of their daytime hiding place at dusk and returning at dawn. Individuals seem to establish personal territory whose invasion by others they may resent. Apparently do not notice fixed food.

None are poisonous in spite of reputation to contrary. All are excellent destroyers of insects and worthy of protection and encouragement. Species here illustrated emits only a small squeaking sound as contrasted with that produced by many related species. Once you become acquainted with geckos you are likely to maintain an interest in them indefinitely.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata

Family Chamaeleontidae

Old World Chameleon
Chamaeleo dilepis

Horned chameleon may be about 1 ft. long, with prehensile tail about as long as body, capable of coiling spirally. Eyes large, forward, capable of independent action. Feet grasping, with toes in 2 groups capable of opposing each other. Body finely scaled. Color changeable. Mouth enormous.

Old World chameleons range from Asia Minor and Syria through North Africa and southern Spain. Essentially arboreal, although they may go to ground at times. Horned and hornless species and some in which horned character is modified by sex. In East Africa, a dwarf chameleon *Brookesia*.

Sexes differ in species by horns, tail length, and size. Some species may give birth to living young while others lay eggs of different numbers. One species lays about 5 eggs under stones on ground. Young, born alive, may be only about 1 in. long.

Can change color at will or may change color due to health. Can capture food by extending tongue suddenly to length of 6 in. in some species. Food almost exclusively insects. Animal may spend most of its life on a single tree. Tail muscular and not shed as in some lizards.

Much folk lore attributes "evil eye" to these animals; may bite vigorously but relatively harmlessly. Not poisonous and could not hurt a human being in any way. Are genuinely useful as destroyers of injurious insects. If considered for pets, should be allowed to remain in natural setting.

New World Chameleon
Anolis carolinensis

Length to about 6 in., with slender tail which in New World chameleons is not prehensile as in Old World species. Body covered with fine scales. Skin dry or only slightly moist. Male with colored extensible fold in throat. Color gray when cool, green when excited or hot, creamy in dark, and some times dull in intense sunlight.

American chameleon or *Anolis* ranges from North Carolina to Florida westward through Gulf region to Rio Grande on mainland and in islands to South. Lives in trees and other vegetation, commonly on green parts.

Male courts by violently bobbing whole body and by distending conspicuous orange throat region in presence of female. Eggs to about a dozen, parchment-covered, laid by female where they may be warmed by sun until they can hatch young chameleons, like adults in general appearance. No parental care shown.

Food exclusively insects caught by stalking, with a final dash and lightning-like thrust of tongue. Will not eat earthworms and cannot exist on sugar and water diet as sometimes suggested. Must have water but will not ordinarily drink it from a dish. Preferable if animal is to be kept in captivity to spray vicinity with atomizer.

Superior insect destroyer and worthy of every protection. Sale of these animals leads to slow starvation and should be prohibited since they are of real value alive and free in their natural environment. Study of color changes, temperature, and emotion interesting. Temperature usually 1.8°F. above surroundings.

Family Iguanidae

Chuckwalla
Sauromalus ater

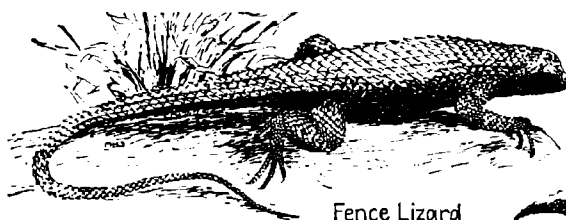
Length to 1 ft. Body broad. Tail thick and flattened, more stubby than in some other lizards and about $\frac{1}{2}$ total length. Head about $1\frac{1}{2}$ in. broad. Scales small. Color of adults dull brown, black, or olive. Abdomen reddish. Scales somewhat rougher about neck.

From southern Nevada and southwestern Utah to Arizona, southern California, and Lower California. 2 American species of genus, the other being relatively uncommon. Lives in deserts of sand or, in parts of range, in dry rocky areas where protection by hiding is possible.

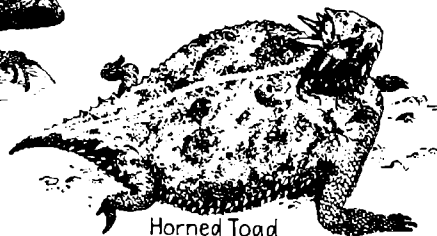
Male more gorgeous than female. Mates in June-July. Young more olive than adults, marbled, spotted with black or with reddish bands mixed with yellow dots, which show more abundantly on tail. Coloration may change with age and vary when awake or asleep.

Food probably solely plants. Prefers buds and flowers, although sometimes eats leaves. In captivity eats lettuce and celery. Gets protection by hiding in crevices and inflating body to prevent removal, by striking effectively with tail, and by coloration. Hardy, with many enemies. Locomotion relatively slow.

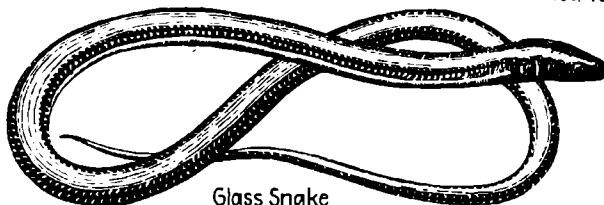
Edible, formerly supplying much food to Indians. Flesh tender and palatable. Not known to bite even when roughly handled. Indians punctured inflated body with wire to remove it from crevice. Favors sunlight and rocks that may be unbearably hot to man. Sticks out tongue while walking, possibly as sensory act.



Fence Lizard



Horned Toad



Glass Snake

PHYLUM CHORDATA. CLASS REPITILIA

Order Squamata

Family Iguanidae

Fence Lizard

Sceloporus undulatus

Length to 5½ in.; tail, 2¾ in. Width ¾ in. Gray, brown, to green, with black crossbars like irregular V's. Pale bands from eye along each side, about 10 scales apart. Male with black blotch under chin and 2 blue abdominal areas. Tail unusually slender. Toes rather long and slender.

Eastern United States, from New Jersey to Florida and west, with 17 other species extending range through United States, on through Mexico to Guatemala, with Oregon marking northern limit on Pacific Coast. Favors dry sandy pinelands or other dry places but mostly in fallen woody plants.

Eggs ¾-¾ in. long, oval with thin papery shells, which indent with slightest pressure. At ordinary room temperatures, if kept moist but not wet, these hatch in 6-8 weeks into small lizards which resemble adults and are able to care for selves immediately.

Food essentially small insects. In captivity, thrives on meal worms, cockroaches, and similar animals. Protection by speedy escape, by shedding tail if caught, and by inconspicuous appearance. May be caught by horsehair nooses. Food captured by pursuit and held by mouth.

Makes interesting terrarium pet and serves great usefulness as insect destroyer. Does no damage. Entirely worthy of protection, which it does not often get. Favors abundance of sunlight and must be kept dry in captivity. Responds almost instantaneously to observed movements.

Horned Toad

Phrynosoma cornutum

Length to 6 in.; tail 2 in. Head with large horns in rows, and with eyes that close readily. Body wide, flat, short, with a row of spines along sides. Tail short, bordered with a row of spines. Gray spotted with brown, and with a middle yellow band. Skin dry, finely scaled. Light beneath.

From Kansas to northern states of Mexico, west to Colorado and New Mexico, with related species extending range westward and southward. Species in United States, 13. At their best in hot dry sandy wastes where heat would seem to be practically prohibitive to animal life.

Young, 6-12; born alive, or rather in thin transparent envelopes that break quickly, freeing young, which resemble parents except that they bear undeveloped horns and lack general spiny appearance of adults; able to shift for themselves immediately after they are born.

Food largely insects, captured on run with wonderful rapidity. In captivity, thrives on meal worms, other insect larvae, cockroaches, grasshoppers, crickets, and other relatively large-bodied animals. Protects self by burrowing into sand, by swelling, by threatening poses, or by expelling blood from eyes in streams.

Highly useful as insect destroyer. Makes excellent pet but probably does not profit by being kept captive. Quickly and actively susceptible to direct sunlight and heat.

Family Anguidae

Glass Snake, Joint Snake

Ophisaorus ventralis

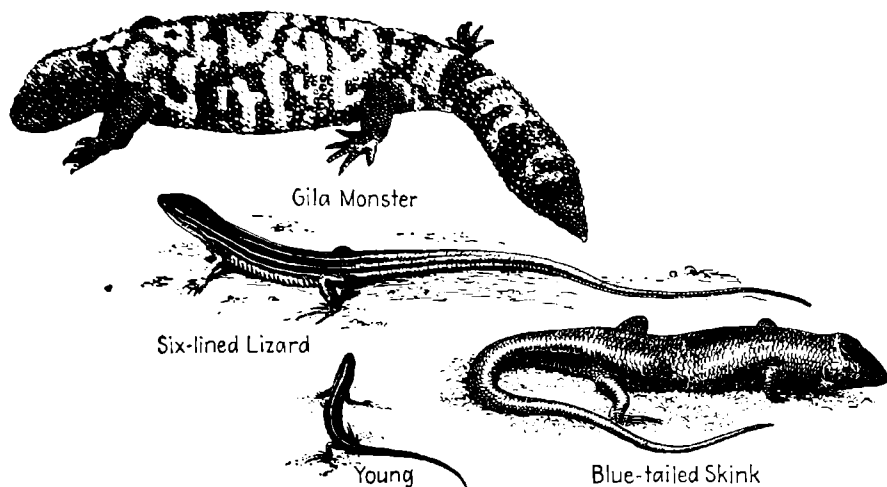
Length to 3 ft.; tail, about ¾ length, brittle and easily shed. Since it has eyelids, ears, and scaly belly, it is not a snake but a legless lizard. Black, olive, or brown, with small green spots on each scale. Greenish-white beneath and generally glassy in appearance.

Southern United States from the Carolinas west through Tennessee, southern Wisconsin, and south through New Mexico and state of Vera Cruz in Mexico. 1 American species in genus, with 2 other genera in family. Inhabits dry meadows and similar places where suitable food may be found.

Stories that glass snake breaks into 2 pieces and that each piece becomes a separate complete snake or that the 2 parts unite again are not founded in fact. Details of reproduction are shrouded in mystery, but some relatives of this lizard lay eggs and it also may reproduce in this way.

Food largely earthworms, slowly moving insects, slugs, eggs of birds, and other small forms of animal life; captured by burrowing and crushed by strong jaws. Obtains protection by remaining hidden, or by breaking in two, leaving foe with useless tail. Enemies include snakes and other animal eaters.

Of little economic importance but of great interest because of habit of breaking in two. Can easily be found but not easily caught. Lost tail is replaced by a sac of flesh. Burrows a great deal, so probably does not favor strong sunlight as do most of its lizard relatives.



PHYLUM CHORDATA. CLASS REPTILIA

Order Squamata

Family Helodermatidae

Gila Monster

Heloderma suspectum

Length to 24 in. Width to 4 in. Tail $1\frac{1}{4}$ length. Legs weak and sprawling. Head heavy. Body, legs, head, and tail covered with bead-like structures. Color gray, with irregular rose patches. Poison fangs in lower jaw. Eyes small and inconspicuous. Motions normally slow and sluggish.

From extreme southern part of Utah and Nevada through Arizona and Sonora, but widely known as side-show attraction in circuses and sometimes much publicized in newspapers. Lives in dry desert-like lands, particularly where soil is loose and sandy. Commonest in vicinity of Gila River in Arizona.

In July-August female, after mating, lays about 1 dozen soft-shelled eggs, $2\frac{1}{2}$ by $1\frac{1}{2}$ in., burying them 3-5 in. deep in sand, where they will be exposed to sun. If kept moist, they will in about 1 month hatch into 4-in. young, each more brilliantly colored than adults and able to shift for selves.

Food, insects, such as ants and birds' eggs. In captivity, eats insect larvae, chopped meat, and eggs most satisfactorily. Can store food in tail, which is plump in well-fed animals and lean in those which have been starved. Apparently enjoys hard-boiled eggs if they are broken up. Can strike with lightning speed.

Only poisonous lizard in United States, but death to humans because of bite is almost unknown. Apparently will not bite unless warmed by sun, and then to inject poison must turn over on back to bite. May froth poison at mouth and reputed to blow this at enemy. Most active at dusk. Poison affects respiration and urine secretion.

Family Teiidae

Six-lined Lizard, Race Runner

Cnemidophorus sexlineatus

Length to 10 in., of which 7 in. may be tail. Legs slender; hind toes long and slender. Dark-brown, with 6 narrow yellow stripes running from head onto tail. Belly and under parts bluish or greenish. Scales small and in some places almost indistinct but like plates beneath.

From Maryland to Florida, west to northern Mexico and Arizona, up Mississippi Valley as far north as Lake Michigan. Most common in southern part of range. 12 species of genus extend range to southern Lower California, Nevada, and California. Found in dry open sunny places.

Female makes nest by hollowing out sand and placing thin-shelled eggs in it. Eggs covered by warm sand by female and left to be incubated by heat of sun. In some species, common for young lizards to have more numerous and more distinct stripes than adults.

Food essentially insects, but has been known to eat eggs of small ground-nesting birds by crushing eggs with jaws and lapping up contents. Can run with lightning speed and seems to anticipate direction of attack. Excellent ability to hide.

Essentially useful as insect destroyer in an area not favored by most insect killers and often ideal for insects. Ordinarily perfectly able to care for self against those who would capture it. May be noosed with horsehair on a pole like a fish pole.

Family Scincidae

Blue-tailed Skink

Plestiodon fasciatus

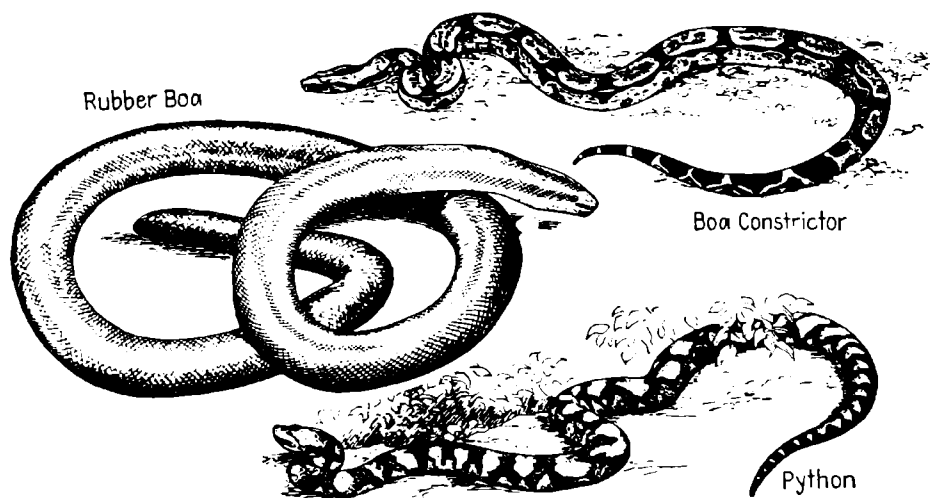
Length to 10 in. Moderately stout. Scales relatively small and close, in from 28-34 rows around body; smooth and underlain with bony plates. Eyelids well-developed. Tail nearly $3\frac{1}{2}$ total length. Adult light green, with 4 black stripes on back and a lateral black stripe on each side between 2 white ones.

From southern New England to Florida, westward up Mississippi Valley to Canada, on to Arizona; with 13 American species of genus extending range to Oregon and Lower California. Found for most part on ground or in decaying logs under rubbish. About 200 species of skinks known in world.

Female lays 3-4 eggs, about which she coils for some weeks until they hatch. Incubation period short for a lizard. Mother pays no attention to young after they are hatched since they immediately shift for themselves. Young jet black, with 5 distinct yellow lines ending in brilliant blue tail.

Food essentially insects, though large skinks have been known to eat birds' eggs, young mice, and other small animals. Activity confined to broad daylight. Adult males can bite vigorously and cause a wound. Tail may be shed in case of danger or capture and may continue to move for some time afterward.

Useful as enemy of insects, rarely acting against interests of man. While it may bite if captured, is not poisonous and need not be feared except for minor inconvenience of a good pinch and possibly a small tear of skin.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Boidae

Rubber Boa, Worm Snake
Charina bottae

Length to 15½ in. of which 2½ in. are tail. Greatest diameter, ½ in. Stout, with tail almost as blunt as head, hence the name 2-headed snake. Scales small, smooth, and shining. Brown, gray, or olive, with a clean yellow unmarked abdomen and no pattern anywhere.

Ranges through humid districts of California, Nevada, Idaho, Oregon, and Washington, usually burrowing slowly and steadily into soft earth or vegetation when given opportunity. Obviously does not crave sunlight. Burrowing habit of 2 small North American boas is similar to that of Old World sand boa, *Eryx*.

Young born alive rather than being hatched from eggs. Much like adults in general appearance. Rubber boa differs from California boa in that former has a single central scale on top of head between eyes, while latter has numerous scales in this area.

Food: this snake, like coachwhip snake, racers, rat snake, pilot black snake, indigo or gopher snake, corn snake, and fox snake, lives essentially on rodents and birds whether they are useful or harmful species. Prey is constricted before being eaten. Hardy, shy, and always seeks retreat.

Rubber boa is essentially useful as a destroyer of burrowing rodents. Makes an excellent pet and thrives well in captivity. Gentle at all times; sometimes interestingly coils itself into a ball which may be rolled about.

Boa Constrictor
Constrictor constrictor

Length to 15 ft. Pale brown above, with 15-20 dark-brown crossbars and with brown spots on sides. Under parts yellowish marked with black. On tail, colors are brick-red, yellow, and black. Claw-like spurs near vent are degenerate hind legs. Usually lies coiled on a tree branch.

Boa constrictor, native of warmer parts of South America, Venezuela to Argentina. Differs from pythons by tooth and skull characters. Closely related to boas of Madagascar and 30-ft. over 250-lb. anaconda or water boa of Central and South America, world's heaviest and America's longest snake.

Boas and anacondas bear living young which hatch from eggs while still within mother. Young of 17-ft. female may number 34, each 27 in. long, 1 in. thick, and like parent at birth. Captive boa constrictors have lived 23 years, longest snake record. Incubating temperature 10.8°F. above surrounding air.

Food: when full-grown, may capture animal size of dog or sheep and after killing prey by constriction or (anaconda) by drowning and constriction, eats animal whole. Once a meal is started snake cannot let go. Savage in wild or when caught. Usually becomes tame in captivity.

Doubtful if these snakes can kill animals as large as horses or that they attack man without provocation, though may be seriously dangerous once aroused. Not poisonous. Flesh is eaten by natives, tastes like veal. Fat is used by natives in curing diseases and skin is used in ornamenting saddles, bridles, and shoes.

Python
Python sp.

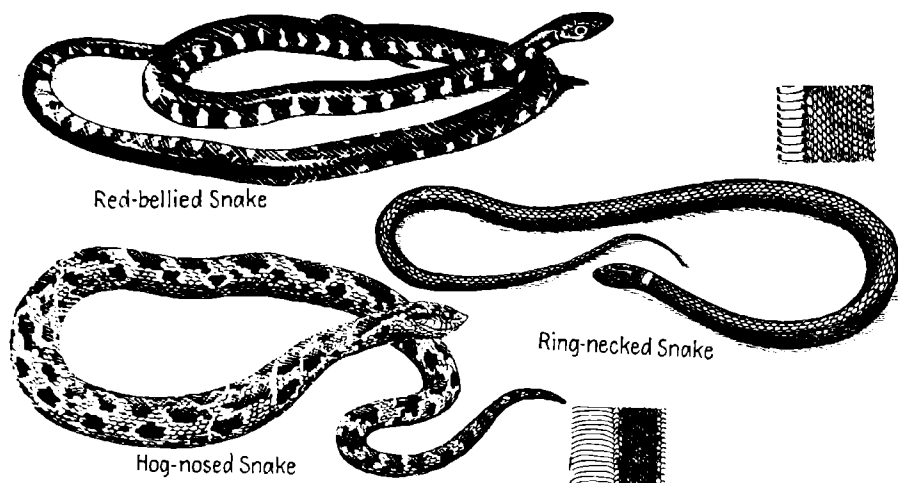
Regal or reticulated python to 33 ft. long, weight 175 lb. Rock python, *P. sebae*, 25 ft. Indian python, *P. molurus*, 30 ft. Australian diamond python, *P. spilottis*, 20 ft. Regal python, light yellow-brown with large blue-black spots and often with iridescent tints.

Regal python native of Burma, French Indo-China, Malay Peninsula, and Philippines, favoring trees near water. Rock python native of Africa. Australian python also known as "carpet snake." Range for all species was probably greater in early days than at present.

Regal python lays about 100 oval leathery-shelled gray eggs, about size of goose eggs, which become white, hard, and round; guarded in a cone-shaped pile by encircling female (whose temperature is about 10.8°F. above surrounding air) for over 50 days; then hatch into young who shed skins in 10 days and are independent.

Food, birds and mammals, captured usually from overhanging tree perch and killed by constriction, then eaten whole. Capture rapid and hard to follow with eye. Tail usually powerful. Not poisonous. Savage when captured; often goes on hunger strike when kept captive. Captive life span, 21 years.

Probably useful in keeping certain small animals in check, but dangerous if interfered with accidentally or intentionally. History records a Roman 75-ft. snake and a Tunisian 200-ft. snake, but these records have probably grown with age and with repeated telling.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Colubridae

Red-bellied Snake
Farancia abacura

Length to 6 ft., of which $\frac{1}{4}$ may be tail. Diameter $1\frac{1}{2}$ in. Dark-purple to black, with large vermillion wedge-shaped blotches on side. Undersides vermillion-red, with irregular numerous black patches. Sides of head red, with large dark spots in a row along upper lips. Tail ends in a hard, harmless spine. (See De Kay's snake.)

Ranges Virginia to Florida, west to Louisiana, north to Indiana. Only 1 American species and some authorities recognize only 2 subspecies. Western subspecies extends range west from western Florida to east central Texas. A burrower, living in mud, wet fallen timber, or sphagnum moss, often in water.

Eggs up to 104, but more commonly from 2-4 dozen, bluntly oval, yellowish-white, with a smooth white parchment-like shell. Young when hatched, about 9 in. long, though some are nearer 6 in. Before snake sheds its skin, entire body becomes a ghostly pale blue, obscuring shiny scales and colors.

Food possibly salamanders, frogs, and conger eels, although this is not well understood. Eats some earthworms in captivity. Requires much drinking water. Movements when undisturbed are slow, but it can swim well and go rapidly over ground. May lie at rest in an obscure hoop.

This is probably the "hoop snake," supposed to take its tail in its mouth and pursue humans or thrust its "stinger" armed tail into a tree and kill the tree. It swings its body vigorously when touched, and tail spine might produce a wound sufficient to cause bleeding. Not poisonous in any way.

Ring-necked Snake
Diadophis punctatus

Length to 19 in. Rarely over $\frac{1}{4}$ in. in diameter. Uniform slate-blue or gray above except for a bright yellow-orange ring around neck. Beneath, bright orange with irregular dark spots separating orange belly and gray back. Scales smooth and glossy, without any keels such as are found on DeKay's or Storer's snake.

Ranges from southeastern Canada to Florida, west to Michigan, Illinois, and Tennessee. Commonly found in rotting stumps, under stones, in moist regions, and usually in wilder unsettled parts of country, though it has been found in city parks.

Eggs about 1 in. long; 1-7; laid in late July in damp or rotting wood; hatch in 6-8 weeks, depending on warmth and moisture available, into young $5\frac{1}{2}$ in. long. Young resemble parents from start except that they may be darker in most parts; grow rather rapidly.

Food, salamanders, earthworms, insects, small snakes, lizards, frogs, and similar small animals, captured and held by mouth, without constriction. Generally gentle. Occasional individuals may strike and bite but they are powerless to injure man in any way. They give off a strong musk scent when disturbed.

Probably not so useful as some other snakes but do no great amount of damage and are never sufficiently abundant to be considered a nuisance anywhere. Make excellent terrarium pets, usually are docile enough to allow persons to become acquainted with them.

Hog-nosed Snake, Puff Adder
Heterodon contortrix

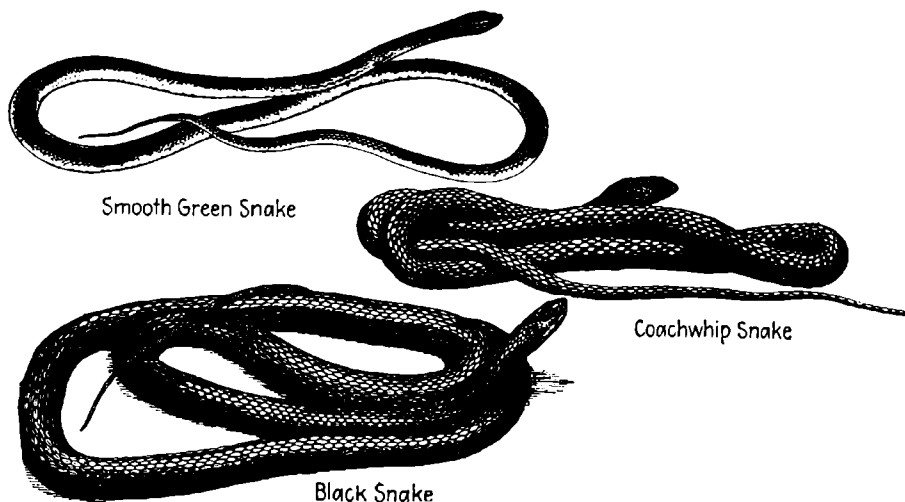
Length to $3\frac{1}{2}$ ft. Scales keeled and in 25 rows. Head of a 2-ft. snake, 1 in. wide and $1\frac{1}{4}$ in. long. General appearance stocky. Brown or red with 28 dark patches between head and tail. Belly yellow, blotched on sides with black. Snout upturned and vicious-looking. Not poisonous or harmful to man.

4 species of genus in America. *H. contortrix* ranges through Eastern States from Massachusetts south to Florida, west to Texas, north to Minnesota, with related species within this range or only slightly increasing it. Found in dry sandy gardens and roadsides exposed to sun.

In early summer, 24-36 eggs, elongate but later becoming spherical, are laid under inches of damp soil; hatch in 5-6 weeks into young $6\frac{1}{2}$ -8 in. long, which resemble parents and shift for themselves immediately. Eggs stick in clusters, absorb moisture, and, during incubation, increase in size about $\frac{1}{3}$.

Food of adults, mostly toads but also frogs, salamanders, cutworms, nestling birds, and insects. Young eat insects. Strikes viciously, hisses, puffs its head, opens its mouth, and turns on its back as though dead when annoyed, but can hardly be made to bite a man. "Playing dead" is its favorite trick.

Its destruction of useful toads makes this snake an enemy of man's interests, but it is hoped that it will never be completely destroyed in its range, since it is the personification of the effectiveness of a bluff even though such action often leads to its death.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Colubridae

Smooth Green Snake
Liopeltis vernalis

Length to 20 in. Greatest diameter $\frac{2}{3}$ in. Scales shining, smooth, in 15 rows, pale green, those beneath being lighter. Anal plate divided. Tail about $\frac{1}{2}$ length. Stout than keeled green snake, which is also yellowish instead of whitish beneath. Keeled green snake also known as "rough" or "Southern green snake."

Smooth green snake ranges from southern Canada through Eastern and Middle States to Florida, Texas, New Mexico, North Dakota, and Colorado, living in open grassy hilly fields and bogs and commonly found under stones. Rough green snake, from New Jersey to Florida, New Mexico, and Kansas. East Asian species.

Eggs capsule-shaped, 1 by $\frac{3}{8}$ in., with thin easily indented parchment shells; stuck together in groups of 2-8, usually under warm stones; hatch in 4-21 days by heat of sun into 5-in. stout dark olive, unusually active snakelings, which first shed skins shortly after hatching.

Food chiefly small animals like insects, spiders, smooth caterpillars, grasshoppers, crickets, and rarely, snails and salamanders; all captured and held by mouth alone and killed by being swallowed whole. Apparently does not eat frogs. Protection is its color. Disposition gentle, rarely offering any resistance.

Highly useful as destroyer of insects. Not poisonous, and not provided with teeth which could possibly tear human flesh; therefore, entirely harmless and inoffensive. Active only in summer months and frequently killed, but worthy of every protection. In captivity eats 4 crickets a day. Burrows in winter.

Coachwhip Snake
Coluber flagellum

Length to $8\frac{1}{2}$ ft., but slender. Without pattern, but with each scale rather distinctly outlined and fore parts darker than rear. Darkest portion dark-brown to black, or sometimes olive, tan, or gray. Outlined scales of tail resemble a braided whip. Abdomen may be white.

Subspecies, 2. One ranges from Virginia to Florida, west to Rocky Mountains. Other is confined to southern Arizona. Found in hills or valleys, in open or wooded territory, in creeks and swamps or dry sandy stretches. Rarely abundant.

Eggs 9-24, laid on ground. Young of eastern subspecies marked with dark crossbands 1-3 scales wide, separated by light bands 1-2 scales wide. In western subspecies, light areas between dark bands in young are 3 scales wide. These patterns disappear with age.

Food chiefly small rodents, birds, birds' eggs, and smaller snakes; western subspecies feeds largely on lizards and other snakes, particularly those of its own kind. Speed is phenomenal, and to catch it, one must almost reach ahead of it. Its take-off is remarkably sudden.

Probably useful as an enemy of rodents and of some other snakes. Makes a poor pet because it does not stand handling well. It does not whip victims with its tail, as Negro slaves were told, but this superstition served admirably to keep escaping Negroes away from unsettled country where coachwhip snake lived.

Black Snake
Coluber constrictor

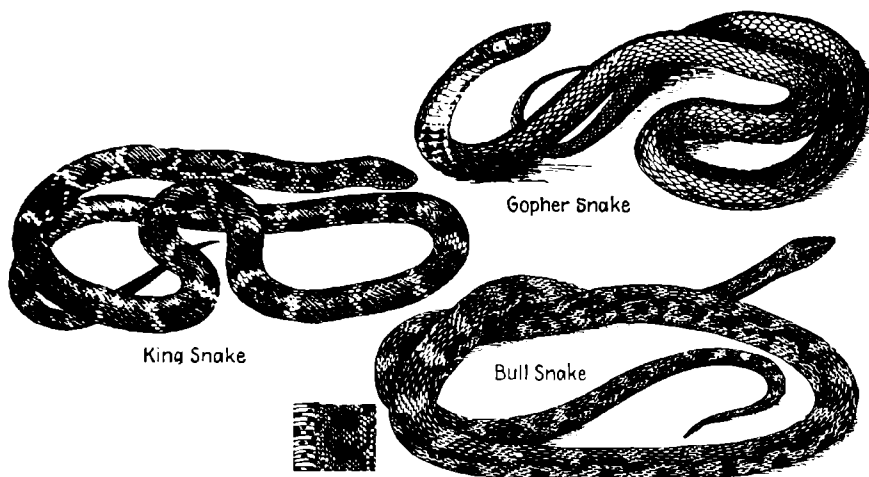
Length to 6 ft., with average diameter 1 in. Scales smooth. Anal plate divided. Slender, plain, bluish-black above; under parts uniformly dark or medium gray. Snout tip sometimes brown. Throat and chin white, and more or less spotted or blotched with dark to rear. Pilot black snake, *Elaphe obsoleta*, has keeled scales.

Subspecies, 2, including black snake and western or blue racer. Former ranges through eastern United States, west to Texas and Great Plains, while latter ranges through Central, Southwestern and Pacific Coast States. Sits itself on walls, tree branches, or ground.

Eggs in lots of 5-20 or more; spherical; $\frac{3}{4}$ -1 $\frac{1}{2}$ in.; snowy white, tough-shelled, smooth and satiny; laid in July in moist decaying wood or moss; hatch in about 4-8 weeks into 12-in. young, with $\frac{1}{4}$ -in. diameters. Young marked with 50-65 black-edged chestnut blotches, which disappear second year when snake is about 30 in. long.

Food, snakes, rats, mice, rabbits, moles, frogs, birds, birds' eggs, and insects; held by jaws and by weight of body but not killed by constriction, in spite of its specific name. Can travel with surprising rapidity over ground or through brush or trees where somewhat similar milk snake would not go.

Probably essentially a useful species in spite of habit of eating birds and frogs. Destruction of rodents, particularly rats, more than makes up for its bad habits. Does not "charm" birds, as claimed. A poor captive animal as it is too nervous and delicate.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Colubridae

King Snake, Chain Snake

Lampropeltis getulus

Length to 6 ft.; tail to 10 in. Scales smooth, in 21-25 rows. Usually black with white or yellow narrow crossbands, which may fork on sides and join one another. Bands separated by 5-10 scales. Abdomen black with yellow blotches. Light belly blotches usually alternating with light backband.

Ranges from southern New England to Florida, with 12 other United States species, including milk snake, covering region west to Nevada and California, south into Mexico and Lower California. Usually on ground in meadows and brushland, but more particularly in wooded areas.

Eggs 10-34, laid in early summer, either on ground or buried under trash, oval, leathery-shelled, soft, and white. If kept too damp, they solidify and young die. Sometimes female remains coiled about eggs a day after laying them. Eggs hatch in 4-6 weeks, into 10¾-in. young, colored like adults.

Food mostly other snakes and rodents, all of which may be captured by pursuit, killed by constriction, and then eaten whole unless they are too large; one recorded as swallowing ¾ of himself. Willing to fight most snakes though normally do not attack larger ones. Immune to poison of associated rattlers.

Useful animal as destroyer of rodents and snakes that may be dangerous or of little use. Makes excellent pet as it becomes docile with handling. May emit an unpleasant musky odor and hiss when disturbed, but is really entirely harmless to man.

Bull Snake

Pituophis sayi

Length to almost 9 ft. One of 4 largest North American snakes. Yellow-brown above, with a row of large rectangular black or reddish-brown blotches on back and similar blotches on sides. Head pointed. Related pine snake *P. melanoleucus* has a whitish ground color, instead of yellowish of bull snake.

Typical bull snake ranges through central United States, northern Mexico, and Texas to Minnesota, Wisconsin, and Alberta. Western bull snake *P. catenifer*, with back blotches close together, ranges from California to British Columbia, and pine snake from New Jersey to Florida.

Eggs larger than hen's egg; tough, leathery-shelled; 10-24; creamy-white, adhering to each other tightly. Incubation about 8 weeks at summer temperatures. Young about 16½ in. long when hatched. Beautiful at all times because of pattern and because of 29-33 rows of scales; lower unkeeled.

Food, mostly gophers, rats, mice, eggs, and rabbits. Kills active prey by constriction, but swallows eggs whole and crushes them afterward. Its hiss may be heard for 50 yd. It varies greatly in disposition but usually makes a splendid pet. Is probably most common pet of "snake charmers."

Pair of bull snakes can rid a barn of grain of its rat and mouse pests, or clean a gopher-infested field of its gophers. Iowa farmers and snake students estimate that a full-grown bull snake is worth \$15 alive as an enemy of crop enemies, and give it corresponding protection whenever possible. It should not be killed.

Gopher Snake, Indigo Snake

Drymarchon corais

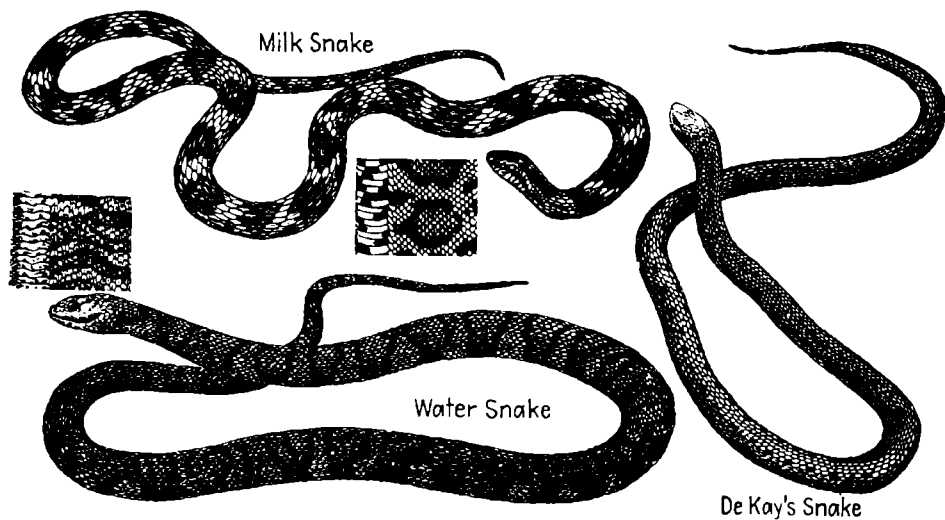
Length to 7¾ ft. Scales smooth. Anal plate single. Plain, shiny, blue-black above and below, with snout and sides of head brownish and chin whitish or orange. Throat is orange-brown, which may extend ¼ distance down belly. Western specimens may be olive instead of black in forward parts.

2 subspecies range from Carolinas to Florida, west to Texas, south to northwestern South America. Favors sandy flats where burrows of such animals as gophers are abundant. Also, if given protection, common about houses and barns where rats may be caught.

Eggs, size of those laid by bantam hen. Little seems to be published on its general life story. Record of one having lived in captivity for 11 years, and much evidence that they are hardy and long-lived snakes. Vary greatly in disposition, some being nervous and others placid.

Writers differ as to its method of getting food, some saying that it does not constrict and others that it does. The author has a motion picture of an indigo snake attacking a huge rattlesnake which it held with its jaws and by weight of its body but did not constrict. Food, a variety of warm- and cold-blooded animals.

Undoubtedly useful as an enemy of rats, rabbits, and other snakes, even though it also eats frogs, birds, and fishes. Commonly exhibited by "snake charmers" because of its active movements, requiring that handler keep renewing his hold as snake seems to slip out of grasp.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Colubridae

Milk Snake
Lampropeltis triangulum

Length to 40 in., a 3-ft snake being $\frac{3}{4}$ in. in diameter. Marked with black-edged blotches of gray, brown, olive, chestnut, or bright red, forming saddles separated by gray and alternating with similar smaller rounded spots along sides. Underside white or gray, strongly flecked with black.

Ranges through eastern North America, Massachusetts to Iowa, south to Virginia and, in mountainous areas, further; in Canada, into southern Ontario. In fields, woods, meadows, often in houses and barns where it follows rats. Unlike corn snake, has single instead of double anal plate, and black instead of red line from eye to mouth.

Eggs much like those of king snake; 6-16; $1\frac{1}{2}$ - $1\frac{3}{4}$ in.; leathery, oval, white, often adhering in a rather compact cluster and buried under ground or in moist rotting wood; laid in early July; hatch in early September into young, $6\frac{2}{3}$ - $8\frac{1}{2}$ inches long, patterned like adults but brighter.

Food chiefly mice and rats, which it pursues into houses and barns. Could not possibly milk a cow or retain milk if it were forced into it. Kills many other smaller snakes, using constriction to kill before swallowing food whole.

One of most useful snakes of area it occupies, and one of most misunderstood and abused. Rumor has it that if one is killed its mate will return to avenge it, and another snake may come to finish a job of rat killing started by first. Is worthy of every protection. Makes an ideal snake pet in every way.

Water Snake
Natrix sipedon

Length to $3\frac{1}{2}$ ft.; tail 8 in. Light brown with dark brown spots and bands across back (see copperhead). Dark blotches on back broadest in middle, alternating with similar areas on sides. Sometimes uniformly brown. Color more brilliant just after skin has been shed. Scales ridged. No poison fangs.

In lakes, streams, and fresh-water marshes. 4 subspecies of *N. sipedon* and 10 other United States species of genus *Natrix*. *N. sipedon* ranges northern and eastern United States to Florida, Texas, Arkansas, Oklahoma, Nebraska, and Indiana. Other species extend range into Lower California.

Young 16-44, born alive in late summer; length varying from $7\frac{1}{2}$ -9 in. at birth and family quickly breaking up, with young shifting for themselves. Many males may try to mate simultaneously with a female but do not fight. European water snake, an egg layer, rarely lives over 2 years in captivity.

Food primarily fishes, either healthy, diseased, or dead; also frogs, aquatic insects, and other cold-blooded creatures available in environment, captured by pursuit if alive and killed by being swallowed whole, the fish often being larger around than the snake. Active night or day. Hibernates.

Probably not useful because of destruction of fish and frogs; however, kinds eaten are usually unimportant slow-moving species, and often are diseased or dead individuals, in which case snake renders a service in preventing spread of disease and acting as a general scavenger.

De Kay's Snake
Storeria dekayi

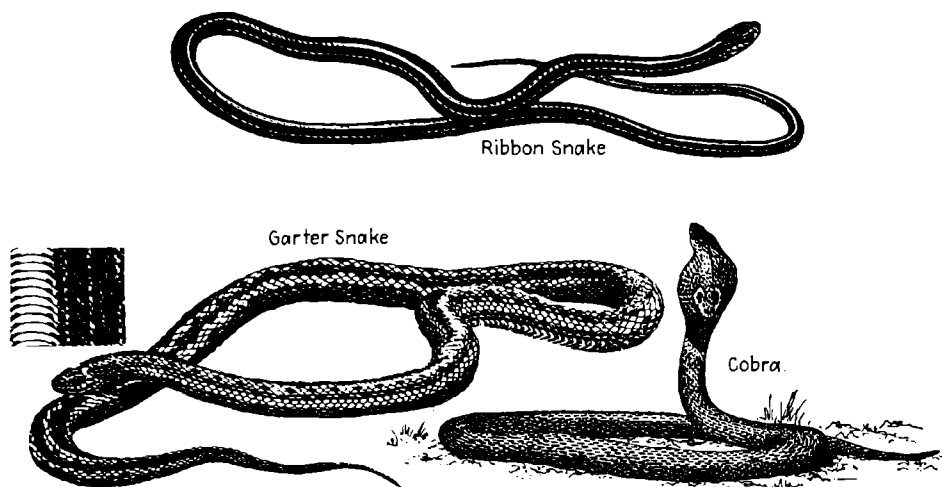
Length to 18 in. but usually not over 1 ft., with $\frac{1}{4}$ -in. diameter. Brown above and pinkish beneath, with keeled body scales. Storer's or red-bellied snake, *S. occipitamaculata*, is vermilion beneath and has 2 light areas immediately behind head. DeKay's snake has a better defined light back stripe.

DeKay's snake ranges from Ontario in Canada to Vera Cruz in Mexico, through eastern North America west to Kansas. Storer's snake has a similar range. Both live in fields where there is loose stone cover and relatively sparse vegetation. They are inhabitants of vacant lots in cities and so are well-known to most boys.

Young 10-20, born alive in August; about 4 in. long at birth and $\frac{3}{16}$ in. in diameter. Young of Storer's snake are even smaller than those of DeKay's snake and are fewer in number, often being as few as 2. Young usually darker than adults.

Food probably slugs, snails, insect larvae, and earthworms, latter being eaten by captive snakes but not so commonly found in free snakes. A gentle, ideal pet, rarely if ever offering to bite even with abuse. Its active tongue indicates an inquiring disposition.

Probably useful as a destroyer of slugs and snails, which are destroyers of useful plants; earthworm-eating habit, not conspicuous among free snakes, is not to its credit. All boys and girls should have chance to learn about snakes through these gentle animals.



PHYLUM CHORDATA. CLASS REPTILIA

Order Squamata

Family Colubridae

Ribbon Snake

Thamnophis sauritus

Length to 36 in., diameter about $\frac{1}{2}$ in. Obviously slender. With 3 bright yellow stripes on dark-brown or black background. One stripe is along middle of back, and side stripes are on fourth and fifth rows of scales above belly plates. Under parts greenish-white.

Ranges from Michigan to Maine through Ontario, south to Mississippi, Alabama, and Georgia. Found most commonly near water, often associated with water snake but staying on shore more than does water snake. See garter snake for range of its relatives.

Young born alive, in litters, averaging about 12 or possibly fewer. Newly born young are about 8-9 in. long, with comparatively large heads, slender bodies, and markings essentially like those of adults. Young and old are usually nervous and resent confinement.

Food, salamanders, frogs, tadpoles, insects, and earthworms, though in captivity will not eat earthworms which its relative the garter snake gorges itself on. Captive ribbon snakes have been fed chopped raw fish successfully, and fish have been found in wild ribbon snakes.

Probably not a particularly useful species because of its appetite for beneficial frogs. A pretty sleek snake, however, greatly admired by those who like to handle them. Not so fast as some racers, but it can move with surprising rapidity and hide most skillfully.

Garter Snake

Thamnophis sirtalis

Length to 36 in. Usually with a central light-colored stripe down back, bordered on each side by a dark stripe. Sides usually darker and under parts lighter. Female often larger than male. Head distinct. Scales ridged and in this species in 19 rows.

3 subspecies and 11 related United States species, including ribbon snake *T. sauritus*. *T. sirtalis* and subspecies range from eastern Canada west through Minnesota to British Columbia, north to 62°N.L. and south to Missouri and California. Found in wet or dry spots, in woods or open.

Mates in early spring; in late summer, 12-70 young are born alive, each about 6 in. long. Stories of snakes swallowing their young may be due to mothers being killed just before their young are to be born, but young are never swallowed for protection. Most active during early spring mating season.

Food, frogs, toads, salamanders, earthworms, crayfish, minnows, insects, and other cold-blooded animals but also known to eat mice and dead birds. In captivity, may be fed chopped fish with earthworms and frogs. Exudes a strong odor from musk glands when captured, and some strike viciously.

Probably not useful to man and destruction of useful frogs, toads, and earthworms is not to its credit. Seems well able to care for itself. Probably most prolific of all our snakes. Has no poison glands and is therefore harmless as an individual.

Family Elapidae

Cobra and Tree Cobra

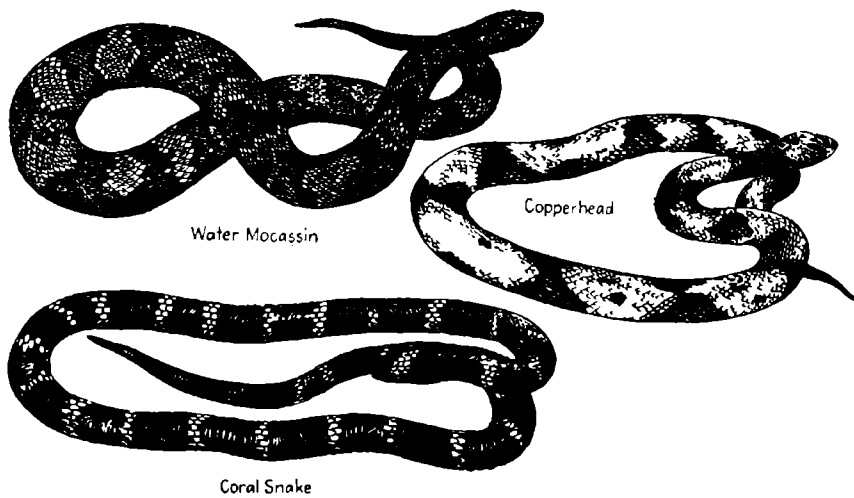
Naja sp. and *Dendraspis* sp.

Cobra de capello, "Kala Nag" of the East Indians, is *N. tripudians*, to 6 ft., with spectacled hood. Asp, Egyptian cobra, *N. haje*, 6½ ft., greenish-yellow. King cobra, *N. hannah*, to 18 ft., olive-yellow, with V crossbands of whitish-yellow. Tree cobra or mamba, *D. angusticeps*, to 14 ft., no hood, olive-green to black.

Cobra de capello, Ceylon and India, west to the Caspian Sea and east to south of China. Asp, African. King cobra, South China, the Philippines, and India. Mamba or tree cobra, Africa over a wide range. Black-necked cobra, from northern to southern Africa. All live on ground except tree cobras.

Cobras de capello pair. Eggs, about 18, laid in vegetable rubbish and leaves, surrounded by female during incubation for 65 days, male taking her place during daily 3-hour absence for food getting. Area near nest protected vigorously by nervous parents during incubation. Young able to shift for selves on hatching.

Poisonous snakes usually excrete poisons through hollow fangs inserted in victim. Food almost exclusively animals, usually warm-blooded. Rattlesnakes usually give a preliminary rattle before striking. Cannot strike farther than their own length. Cobras usually coil and erect the fore part of their body, then expand a "hood" before striking much of their length. Cobras can "spit" venom (not saliva) at eyes accurately for 7 ft. Mambas give no warning but strike with remarkable speed. Coral snakes normally do not bite unless disturbed, and copperheads are not particularly aggressive. New fangs replace those lost by use or accident and some cobras can bite effectively 20 times in relatively quick succession. See next 2 pages for nature of poisons and treatment of injury.



PHYLUM CHORDATA. CLASS REPTILIA

Order Squamata

Family Elapidae

Family Crotalidae. PIT VIPERS

Coral Snake, Harlequin Snake *Micrurus fulvius*

Length about 3 ft.; diameter, $1\frac{3}{4}$ in. Ringed with red, yellow, black, and yellow, with yellow rings narrower than red and black; red rings have black dors or spots. Snout black, with wide yellow ring around middle of head. Red touching yellow is important identification.

3 subspecies recognized. *M. fulvius* ranges South Carolina to Florida, west through Gulf States, Mississippi, and Mexico, south to Central America. *M. eryxanthus* ranges from southern New Mexico, through Arizona and northern Mexico. Usually burrows in fields and so is not commonly found.

Eggs 3-12, elongate, laid in early summer, in decaying bark or damp soil; hatch in midautumn, into very active young, 7-9 in. long, which bite quickly if handled. Does not bite readily, but hangs on and chews when it does bite.

Water Moccasin, Cottonmouth *Agkistrodon piscivorus*

Length to 60 in., circumference to 10 in. Color pattern obscure; olive, with wide dark crossbands in the cottonmouth *A. piscivorus*; dark brown, with darker crossbands bordered with yellow, in Mexican moccasin *A. bilineatus*. Head distinct. Plates on under portion of tail, in 1 row for $\frac{2}{3}$ length.

A. piscivorus ranges from Virginia to Florida, west through Gulf States. Irritable, fighting vigorously when captured, opening mouth and showing white interior (cottonmouth) but usually calming down if not further molested. In captivity, tame. Lives for most part in marshes and shallow waterways.

Young are produced living; 1-12; if food is available, may in 2 years reach size of parent. In captivity, have been known to live for 21 years. Food mostly fish but includes frogs and other small animals of aquatic environment in which it lives. Poison is virulent but causes few deaths.

Copperhead *Agkistrodon mokusen*

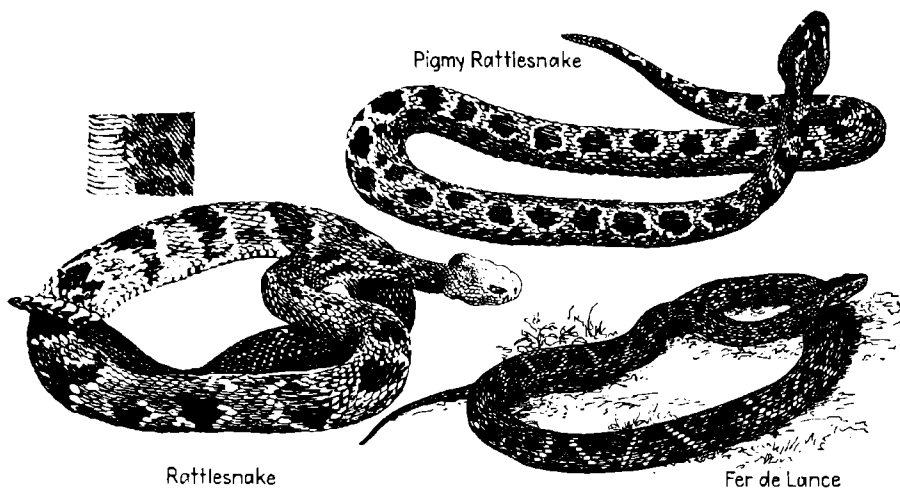
Length to 40 in., diameter to $1\frac{1}{2}$ in. Ground color hazel-brown, with chestnut-brown blotches narrow in middle of back and broad at sides, with isolated spots in remaining lighter areas; sometimes described as "hourglass" markings. Water snake has dark markings which are broadest at center of back instead of sides.

Ranges from Massachusetts to northern Florida, west to Illinois, Arkansas, and eastern Texas. In North found in early spring around rocky slopes where it and timber rattlers hibernate. In summer found in woods, fields, and swamps where its color pattern matches ground perfectly.

Young 3-9, born alive in late August and September in northern part of range usually when female is about ready to go into hibernation; like adults except that they have bright sulfur-yellow tails. Food of copperheads is frogs, snakes, and mice.

Probably 5,000 persons die each year in India from cobra bites in spite of fact that cobra there is not always aggressive. In United States, 1 out of 8 adults severely bitten by rattlesnakes dies when no treatment is administered but only 1 out of 30 where good treatment is given. Copperhead and pygmy rattlesnake are rarely able to inflict fatal injury to man. Rattlesnakes famous in dances of Indians; cobras, in exhibitions of Indian jugglers; and the asp, mentioned in the Bible and famous in history as causing death in 30 B.C. of Cleopatra. Kipling in his "Jungle Books" made "Kala Nag" famous and dramatized the enmity of the cobra and the mongoose in his classic "Rikki-tikki-tavi." Cobras enter houses at night in search of rats. Some consider the asp a mark of regal dignity. (See also the last paragraph under "Cobra," p. 467.)

Bites of rattlesnakes and similar poisonous snakes cause instant sharp burning pain, followed by swelling within 10 minutes and profuse bleeding, often followed by nausea and faintness. Reassure patient with information that only 1 in 30 severe bites, if treated, is fatal. Apply ligature a short distance above bite to stop flow of lymph but loosen it every 15 minutes. Make crosscuts with sterile razor over fang marks equal to fang length, with novocain if available. Suck with sore-free mouth or suction device for 30 minutes. Administer antivenin as directed. As swellings develop, relieve with $\frac{1}{2}$ in. cuts around swollen area. Get doctor's help. Do not use potassium permanganate and do not use whisky, which increases circulation and consequent absorption of venom.



PHYLUM CHORDATA. CLASS REPTILIA
Order Squamata. Family Crotalidae. PIT VIPERS

Rattlesnake

Crotalus cerastes et al.

Timber rattlesnake, length to 5½ ft. Head broadly diamond-shaped, with scales over top. Scales in 23-25 rows, keeled. Pair of movable poison glands on upper jaw. Color yellow-brown, with irregular yellow crossbands with black spots. Tail of adult black, with dry-scale rattle which grows with age.

15 species of rattlesnakes in United States. 10 live in Southwest and include tiger, Pacific, white, green, and horned. Diamondback is of south-eastern United States. Massasauga and prairie, in central United States. Texas, from Texas and California. Other species cover most of Americas.

Timber rattlesnake bears 7-12 young alive, usually in September, each young bearing a single burton at end of tail. Skin shed once before winter hibernation, starting the rattle which increases whenever skin is shed, possibly 3 times a year. Rattlesnakes have lived 13 years in captivity. Bounties offered sometimes for them. Highly heat-sensitive.

Snake poisons vary in effect, rapidity of action, and amount. King cobra bite may kill a man in 1 hour, while rattlesnake bite, if fatal, may take nearly 1 day. Venoms of cobras, coral snake, and South American rattlesnake have much neurotoxin which dissolves cell tissue, destroys or paralyzes nerves, particularly those affecting breathing, damages blood cells, and ruptures walls of capillaries and other blood and lymph vessels. Venom of copperhead and native rattlesnake "digests" animal tissue, keeping blood from clotting and aggravating internal bleeding. Venom of Russell's viper causes blood clots. All venoms greatly reduce ability of victim's blood to combat infections. If a diamondback rattlesnake carried only the most poisonous venom, it could kill 400 men or 135 horses. Fortunately, it does not.

Pigmy Rattlesnake or Massasauga
Sistrurus catenatus

Known as "ground rattlesnake." Length to 17 in. Unlike true rattlesnakes, top of head is covered with large symmetrical shields rather than with small crowded scales. Pits on sides of head and rattle on end of tail are same as with true rattlesnakes. Poison glands on jaws.

Pigmy rattlesnakes with gray ground color are southern pigmy or ground rattler, *S. miliaris*. Those with brownish ground color are massasauga, *S. catenatus*, from New York to Kansas and north to Canada in which dark back blotches are close together. Back blotches are more separate in Edward's massasauga of Southwest.

Young born alive, usually in small numbers, of small size, and capable of coiling in 1½-in. circle. A 2-ft. mother may give birth to 7-9 young. Massasaugas are commonest in marshy bogs. Their rattle is so faint as to be unheard by many people. Bite is rarely fatal to man.

Fer-de-lance

Bothrops atrox

Bushmaster

Lachesis mutus

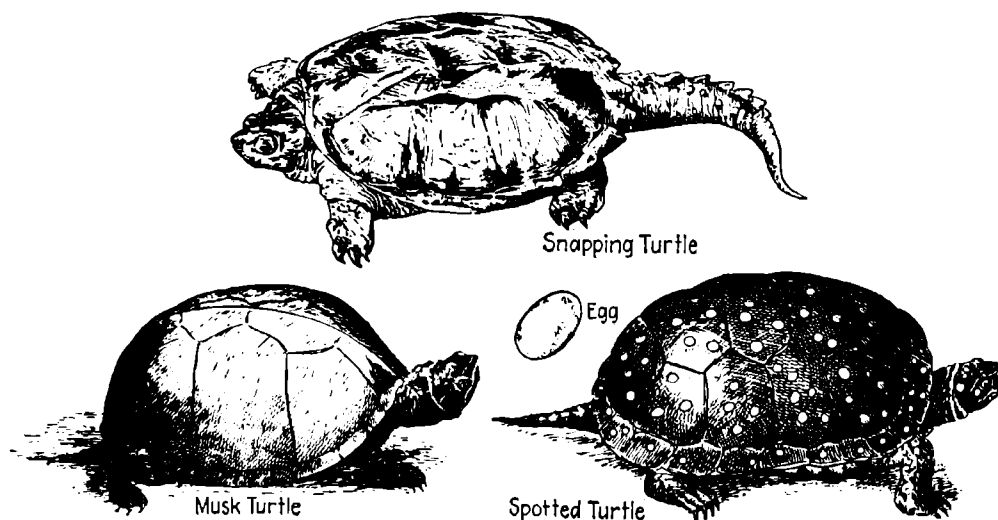
Fer-de-lance: length to 6 ft., with a conspicuous lance-like head about 2 in. thick and with exceptionally long poison fangs for its size; brown with black markings. Bushmaster: length to 12 ft., largest American poisonous snake; reddish-yellow with dark crossbars and a black stripe from angle of jaw to eye.

Fer-de-lance ranges through Mexico, Central America, tropical South America, and West Indies, usually hiding quietly in jungles during day. Bushmaster ranges through Central and tropical South America in damp hot forests, living much of time in holes made by small animals that burrow in ground.

Fer-de-lance gives birth to living young with bright colored tails, which shift for themselves. Bushmaster, unlike other pit vipers, lays eggs from which young are hatched. These are laid in burrows which snake haunts.

Fer-de-lance eats small warm-blooded animals captured at night and killed by poison injected through long hollow fangs; not so dangerous in early day, when poison has been exhausted by night's hunting. Bushmaster is bold and aggressive, with fangs nearly 1½ in. long, which give a great volume of virulent poison. Both are night hunters.

Fer-de-lance's bite is deadly poisonous but not so bad as that of bushmaster, whose victims have been known to die within 10 minutes of having been bitten. While these snakes are relatively closely related to rattlesnakes, they do not have characteristic rattles.



PHYLUM CHORDATA. CLASS REPTILIA Order Testudinata

Family Kinosternidae

Musk Turtle, Stinkpot *Kinosternon odoratum*

Length of upper shell to $7\frac{1}{2}$ in., average 5 in.; under shell does not cover soft parts of body. Back without keel. 2 yellow stripes on either side of head. Male with blunt nail on long tail, concave under shell, with horny scales on inner side of hind limbs. Female with short tail, with pointed nail.

From southeastern Canada and eastern United States, west to Michigan, south through eastern Texas, southern Missouri, and eastern Oklahoma. Common in marshes, pools, canals, bogs, and bayous with deep muddy bottom and abundant water plants. Favors relatively deep water. Essentially aquatic.

Breeds in early spring. Eggs white, brittle, $1\frac{1}{2}$ by $\frac{3}{5}$ in.; laid singly or to 9, on surface or in nests underground; hatch in 60 days (temperature up to 98°F .) or 90 days (temperature up to 77°F .) into 1 by $\frac{4}{5}$ -in. young, which in 3-4 years show sex differences and may live at least 23 years.

Food mostly animal matter eaten voraciously, but also may eat water plants, cow dung, or garbage found on the bottom and torn by jaws and claws. Feeds either night or day. May bite, and once having bitten hangs on persistently. Gives off offensive musk from 2 glands. In captivity eats raw meat or fish and vegetables.

May destroy fish nests and some fish but does little damage and may be considered scavenger even though occasionally it bites baited hooks, to the disgust of anglers. Flesh useless as food for man, since role as scavenger is main claim to fame for this often popular aquarium animal.

Family Chelydridae

Snapping Turtle *Chelydra serpentina*

Length to 3 ft.; female considered the larger, with vent nearer end of tail. Upper shell 1 ft. long, with 8-in. lower shell not covering legs, neck, and tail. One reported to have weighed 86 lb. Back with 3 broken ridges of coarse scales, with a border row giving a notched outline to rear.

Eastern North America from southern Canada to Gulf of Mexico, west to Rocky Mountains. Western tributaries of Mississippi River are followed to their sources, south to Ecuador. Lives for most part in slow rivers, shallow ponds, and mud-bottomed lakes. Does not sun on a log like many turtles.

Mates April-October. Female leaves water to dig nest on shore and lays 24-30 spherical, $\frac{4}{5}$ -in. white thin-parchment-like hard-shelled eggs, about 5 in. under soil; hatch in 90 days or over winter into young with yolk sac and tails as long as upper shell. May live more than 25 years.

Food varies greatly with conditions. Usually largely animal matter but in some individuals over half of stomach contents may be water plants; can digest plant materials satisfactorily. May move slowly but can attack with lightning speed with head. Seeks food night or day. Hibernates through winter in mud under water.

Excellent as food in soups or stews. May serve as scavenger in waterways. May destroy ducks and some useful fishes and on land, if bothered, may severely injure man. Too dangerous to be considered pet at any time. Formerly were fattened in swill barrels until fat enough to be killed for food.

Family Testudinidae

Spotted Turtle *Clemmys guttata*

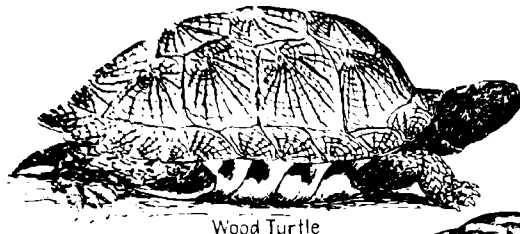
Length: male, upper shell to 5 in.; width, $3\frac{2}{3}$ in.; height, $1\frac{1}{4}$ in. Under shell $2\frac{2}{3}$ by $1\frac{1}{4}$ in. Male with dark-brown eyes, dusky horny jaws, black throat, black neck, and concave lower shell; $4\frac{3}{4}$ -in. animal has $1\frac{1}{4}$ -in. tail. Female with orange eyes, pale yellow jaws, and smooth neck. Both with backs unridged; black with round yellow spots.

Found in small pools and ponds from Maine to northern Florida, through north and west to southern Michigan but apparently not north of Great Lakes. Sometimes found in brackish marshes with rougher shells, and sometimes in woods near streams but almost always in vegetation which gives cover.

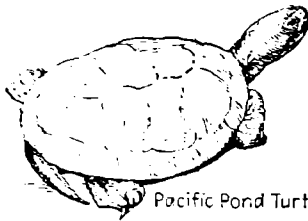
Males fight, then pursue females. Eggs 2-4; white, elliptic, $1\frac{1}{2}$ by $\frac{3}{5}$ in.; buried in sand; probably hatch in 82 days into young, with single spot on each back plate, these spots increasing in number with age, with spots later developing on legs and tail. Under shell yellow at hatching. May live over 42 years.

Food largely insects, including beetles, flies, dragonflies, worms, slugs, crustaceans, spiders, and tadpoles, mostly eaten under water. In captivity, eats raw chopped meat, fish, shellfish, meal worms, water plants, and lettuce, mostly under water.

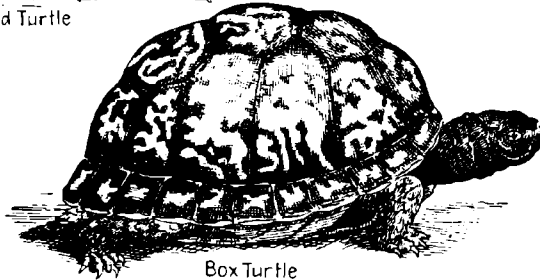
Of little direct economic importance to man and of no serious damage to his interests. Used as an experimental animal by psychologists; have shown ability to learn to solve mazes, have fear of falling from certain heights, and in some cases, show prolonged preference for one individual of different sex.



Wood Turtle



Pacific Pond Turtle



Box Turtle

PHYLUM CHORDATA. CLASS REPTILIA
Order Testudinata. Family Testudinidae

Pacific Pond Turtle
Clemmys marmorata

Average upper shell $6\frac{1}{2}$ by $5\frac{1}{2}$ in., lower shell $6\frac{1}{10}$ by $4\frac{1}{3}$ in. Length of tail $2\frac{3}{5}$ in. One with 7-in. upper shell is large and weighs 2 lb. Upper shell olive to black, with each shield with many yellow-brown or black dots and dashes. Under shell yellow and in male, concave.

Ranges along Pacific slope from Puget Sound to San Diego, Calif., being commonest turtle in that part of country. It favors lakes, marshes, and even enters brackish water or the sea. It is not known in Canada.

Eggs white, hard, elliptic, $1\frac{3}{8}$ by $\frac{1}{2}$ in., laid June-July: 5-11, in a nest; in open field, sandy bank, or hillside near water and left to hatch by heat of sun and earth. Young with shells nearly round, but grow slowly, so that in 10 years an upper shell of $5\frac{1}{2}$ in. in length is attained.

Food aquatic insects and other animals including carrion and dead fish. Hibernates in mud, but during summer often basks in sun in companies at edges of pools or lies on bottom, moving about only in early morning or evening. Strictly aquatic except for egg laying. Must come up for air once in 3 hours.

Alive, probably a useful scavenger and insect check. Good to eat and has a market value up to 50 cents apiece; therefore, has been extensively and probably unwisely trapped for sale. Since its growth is so slow and since it congregates in numbers, its harvest should be regulated to maintain its abundance.

Wood Turtle
Clemmys insculpta

Average upper shell, 7 in.; maximum, 9 in. by 5 in.; under shell, $6\frac{1}{2}$ by 4 in.; height $2\frac{3}{4}$ in. Scales roughly sculptured with concentric lines. Male with concave lower shell, longer thicker claws, with vent on extended tail beyond hind edge of shell. Female with convex shell and vent not beyond hind edge of upper shell.

Eastern United States from Maine to District of Columbia through southwestern Ontario, west through Iowa. Found in fields and woodlands, spending most but not all its life on land. Closely related to Pacific pond turtle *C. marmorata*, to spotted turtle, and to Muhlenberg's turtle.

Mates in spring and fall. Eggs in North, laid in June in midafternoon; buried in sand in lots of 2-12; elliptical, $1\frac{3}{8}$ by 1 in.; white with parchment-like shell. Young with nearly round shell and tail almost as long as upper shell, with soft parts gray instead of red of adult.

Food either plants or animals, but preferably plants including fruits, berries, tender leaves, and mushrooms but also some insects, earthworms, slugs, snails, and carrion. Has unusual ability to climb. Apparently has rather high intelligence. Normally it will not bite but when annoyed can be induced to do so.

Flesh edible, but animal is so scarce that it should be protected by law everywhere as it is in some parts of its range. Harmless and makes an interesting, easily cared for terrarium pet, doing best where a temperature of 68-75°F. can be maintained and where cover and food are present.

Box Turtle
Terrapene carolina

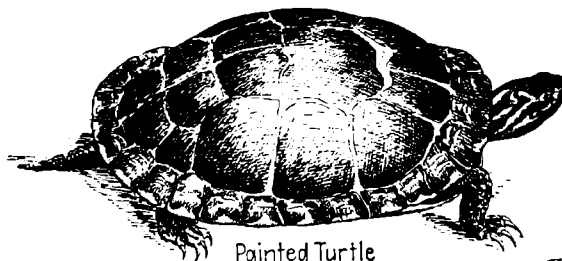
Upper shell 5 in. long, $3\frac{3}{4}$ in. wide; $2\frac{1}{4}$ in. high. Lower shell to $4\frac{3}{8}$ in. long by $3\frac{1}{4}$ in. wide. Male with bright red or pink eyes. Female usually with dark red, yellow, or brown eyes. Back high and arched, with a blunt middle ridge. Uniformly dark-brown or black with yellow spots and streaks.

Ranges eastern United States from Maine to Georgia, west to Tennessee and western Illinois and northward to central Michigan, with related species extending range farther west and south. Found in open brush-covered country, often remaining for years in relatively restricted area.

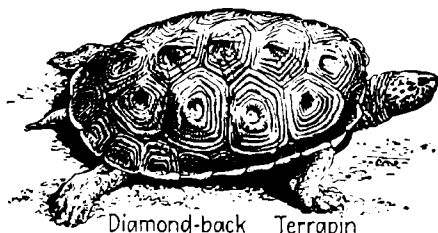
Eggs 3-8, like hen's egg, with thin flexible white shells; $1\frac{3}{8}$ by $\frac{1}{2}$ in.; laid in cavity in ground; hatch in 3 months into young with yellow, keeled under parts, about $1\frac{1}{2}$ in. in diameter; 5-in. shell in 5 years. Male may mature at $4\frac{3}{4}$ in.; female at 4 in. Live over 40 years.

Food, plant material and worms, slugs, snails, and insects procured in decidedly leisurely travels. Protected efficiently by shells, which close so tightly that a pencil cannot be forced between to reach soft tissue. Hibernates in soft soil below frost line, often going down 2 ft. May aestivate in mud in hot weather.

Useful destroyer of insects and of garden pests generally. Makes a good pet requiring relatively little care but entitled to worthy consideration. Always harmless. Good to eat but protected by law in many states and should receive universal protection at all times.



Painted Turtle



Diamond-back Terrapin



Desert Tortoise

PHYLUM CHORDATA CLASS REPTILIA

Order Testudinata. Family Testudinidae

Diamondback Terrapin

Malaclemys centrata

Head and neck without longitudinal yellow stripes. Shields of upper shell with concentric ridges and grooves. Length of upper shell: female to $7\frac{1}{2}$ in., male $4\frac{3}{4}$ in. Sides of shell about parallel. Head relatively large. Female with larger head, more rounded snout, shorter tail, and deeper shell.

2 subspecies, northern and southern, and 1 related species with 3 subspecies. Southern ranges along Atlantic Coast from Cape Hatteras to Florida; northern, from Buzzards Bay to North Carolina, Delaware, and Chesapeake Bay. In salt or brackish bays and in marshy tracts with mud bottoms.

Female may lay fertile eggs for years after 1 mating though only 4% of eggs are fertile after 4 years; may lay 1-5 times a season. Eggs $1\frac{1}{8}$ by $\frac{5}{8}$ in., white; hatch in 90 days into young with $1\frac{1}{10}$ -in. shells. Male matures in 4-9 years, with $3\frac{1}{8}$ - $3\frac{1}{2}$ -in. shell; female, 4-9 years, $5\frac{1}{2}$ -in. shell. Life span over 40 years.

Food, in wild, snails, crabs, worms, and possibly some tender plants. In captivity, chopped fish, crabs, clams, and insects, preferring to eat underwater. Experimental farms usually free young for stocking at 8-month age. Rearing in captivity is hazardous because of expense of feeding, variable market, and length of time necessary.

Once considered one of most expensive luxuries as food for man when turtle with 7-in. shell brought \$7 with additional dollar for each additional $\frac{1}{2}$ in. 160,000 reared at Beaufort 1909-1941. See reports of Beaufort, N. C., Station for advice on raising; or "Turtles," by Clifford Pope, published by Alfred A. Knopf, Inc.

Painted Turtle

Chrysemys marginata

Upper shell to $7\frac{1}{4}$ in. long by $4\frac{1}{2}$ in. wide by 2 in. high. Lower shell 6 in. long by $3\frac{3}{4}$ in. wide, with a lobe in front. Back wide, unnotched, unridged, smooth, olive to black, with red marks on sides. Lower shell yellow. Tail of large male $1\frac{3}{4}$ in. long; of equal-sized female, $1\frac{1}{4}$ in.

4 subspecies and closely related *C. picta* range from New Brunswick to Georgia and west through Mississippi Valley, on through Montana and the Columbia River valley, British Columbia, south to New Mexico and northern Mexico, with type species and subspecies in Mississippi Valley. Common in ponds.

Eggs 5-8, smooth, white, glazed, with soft shells; $1\frac{1}{8}$ by $\frac{5}{8}$ in., blunt, egg-shaped; laid in early summer, in nests usually near stumps near edge of water; hatch in summer into little 1 by 1-in. turtles; grow to about $1\frac{1}{2}$ in. at 6 months; to $2\frac{3}{8}$ in. at 18 months; to $3\frac{1}{2}$ in. at 52 months, or breeding age.

Food, aquatic plants and animals, dead or alive, eaten only under water. In captivity, thrives on beef, earthworms, or lettuce but may eat fishes as well. Male breeds at smaller size than female; male, at about 3 in. while female begins at 4 in. with growth thereafter slower. Adult female larger than male.

Serves as scavenger of shallow ponds. Of no value as food since flesh is poor. Almost impossible to make it bite a person but will take a hook with bait repeatedly even after having just been caught. Hibernates in cold weather. Not protected by law.

Gopher Turtle, Desert Turtle

Gopherus agassizii

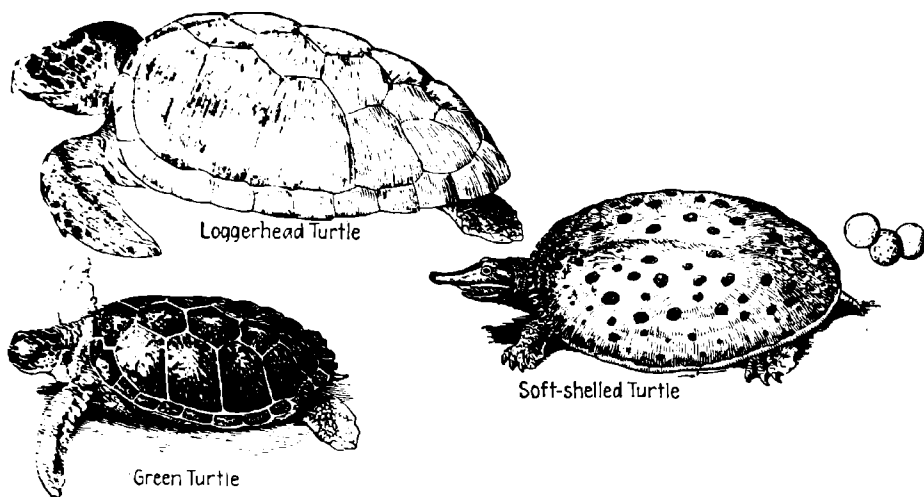
Upper shell to 10 in. long, 7 in. wide, $4\frac{1}{2}$ in. high. Eastern gopher turtle smaller. Fingers and toes on each limb club-shaped and closely bound together, with only last joint free. Scales with conspicuous concentric markings. Related Galapagos tortoise reaches length of 4 ft. and weight of 500 lb.

Desert tortoise or gopher turtle ranges through deserts of southwestern Arizona and southeastern California into Nevada, with 2 related species extending range east through southern Arkansas, southern South Carolina, south to Florida, Gulf States, Texas, and north-eastern Mexico, *G. polyphemus* being commoner eastward.

Male with concave lower shell shorter to rear, tail longer. Eggs white, with thick hard rough shells, elliptic and nearly 2 in. long, buried in sand, in sun; hatch into young $1\frac{3}{8}$ by $1\frac{1}{8}$ in., with shells hardening in 3 years but growing to $2\frac{3}{8}$ in. first year. A 6-in. female grew to $8\frac{1}{2}$ in. in 27 months.

Food largely plant materials such as clover, lettuce, bananas, berries, and vegetables. Individuals have been tamed to accept food from hand. Animals are harmless; do little to protect themselves except rely on their shells. Favor temperatures between 85° - 95° F. Move 20 ft. per minute or 5 miles per day.

Useful as food but should not be eaten because of danger of extermination. Interesting scientifically as descendants of species more common in past. Must have dry environment at all times to prosper or to survive. Huge relatives are popular in parks or zoos where they can carry young children on their backs.



PHYLUM CHORDATA. CLASS REPTILIA

Order Testudinata

Family Cheloniidae

Green Turtle *Chelonia mydas*

Shell covered with large horny shields. Back without longitudinal ridges. 4 pairs of side shields. Shields of back not overlapping except in young. Usually a single claw on each limb. Single pair of shields on top of head. Back shells to 46 in. long. Weight to 850 lb. Limbs paddle-shaped.

Found in sea or on seashore north to Massachusetts and through West Indies; commonest Bermuda turtle. In Pacific, north as far as San Diego and abundant in southern Lower California. Usually within 35° of equator. Known from Florida Pleistocene. Comes to shore to breed.

Breeds any time. Eggs nearly spherical, white, soft-shelled, 1½ in., mostly laid March-May in nest at night, above high tide; hatch in 47-52 days. May lay 7 times a year for 2 weeks, 100 eggs each time. Young add ½ in. to shell and 1 lb. each month, reaching 8-in. shell first year. Female matures with 35-in. shell; 44-in. shell in 10 years.

Food almost exclusively marine algae and plants, more succulent parts being favored. Young eat more animal matter than adults. May sleep at sea. Tail of male extends beyond tip of extended flippers; of female, only to edge of upper shell. Captives have added 50 lb. in 9 years; another attained 18-in. shell at age of 28 months.

Source of turtle soup, and basis of industries worth many thousands of dollars. Oil made from eggs and animal. Females with shells under 40 in. long should be left to mature. Shell of no value. Valuable tortoise shell comes from related hawksbill turtle. Undoubtedly, most valuable of all turtles and worthy of wise management.

Loggerhead Turtle *Caretta caretta*

Pairs of scales on side, 5. Limbs: 2-clawed in Atlantic species and 1-2-clawed in Pacific species. 2 pairs of large shields between eyes. May reach weight of 450 lb., though 300-lb. animal with 3-ft. back shell is large. Tail of male extends beyond extended hind flippers; of female, barely to rear edge of upper shell.

Found in tropical and subtropical Atlantic Ocean, north in summer to Cape Cod but mostly in Carolina-Virginia region; also in Mediterranean. Pacific species ranges south of California, particularly in Lower California. Atlantic species known from Pleistocene of Florida. Favors vegetation-laden ocean currents.

Eggs white, nearly spherical, 1¾ in., soft-shelled; laid in nest above high tide, in sand about 10 in. under surface; probably 3 times a season; 80-150 at a time; hatch in 2 months. Young reach shell length of 21 in. and weight of 42 lb. in 3 years; to 25 in., 81½ lb. in 4½ years; probably mature at 200 lb.

Food largely animal matter such as hermit crabs, shellfish, conchs, and Portuguese men-of-war. Can bite off end of large conch and extract soft animal inside. Young at first move away from broken horizon, downhill, toward opaque blue, away from transparent orange, red, or green, without respect to sun.

Eggs are eaten and young turtles are sold for their flesh, but old ones are too rank to eat. Oil extracted from old turtles used for softening leather. Musk given off at times. Inferior in value in all respects to green turtle and hawksbill turtle.

Family Trionychidae

Soft-shelled Turtle *Trionyx ferox* (Southern) *T. muticus* (Spineless) *T. spiniferus* (Spiny, illustrated)

Back leathery, light brown with darker spots. Without spiny tubercles along front of back (spineless); with small tubercles along front of back (Southern) and with prominent spines along front of back (spiny, illustrated). Back about 15 by 11 in., flexible. Undersides with legs, neck, and tail poorly protected.

4 American species: Southern, from South Carolina to Florida and Louisiana; spineless, through middle and northern tributaries of the Mississippi and St. Lawrence rivers; spiny, in Mississippi tributaries west to Colorado and Montana, in St. Lawrence tributaries, and east to Vermont, New York, and Pennsylvania; other, Texas, southern Oklahoma, and Arkansas.

In spiny female tail extends barely to rear of shell; male's tail longer. Eggs spherical, 1½ in.; hard, brittle, white; laid in lots of 12-32, 2-4 times a season, in nest 1 ft. underground June-August; hatch in 2-10 months. Young, 1-in., circular; to 7 in., fifth year; breeds first in sixth year.

Food probably largely animal matter such as crayfish, minnows, frogs, earthworms, with weak appetite for plant foods. Food swallowed whole. Jaws strong. Can strike accurately and suddenly but if held by tail cannot reach captor. Essentially aquatic but suns on land, although it remains alert there to danger.

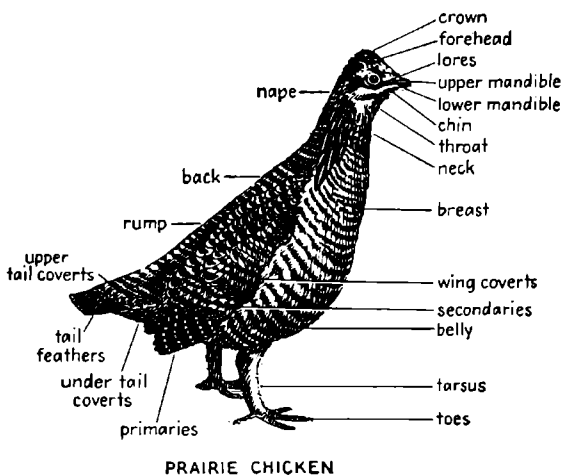
Flesh good to eat and turtles are often sold in market for food. May damage a careless human by their bite and destroy some fish and fish food, but probably do no damage sufficient to offset food value. Turtles' temperature varies from 33.6-84°F., favoring 79°F. for most activity; average 1.8-5.4°F. above surroundings.

BIRDS AND MAMMALS, THE WARM-BLOODED VERTEBRATES

It is without apology that we devote approximately $\frac{1}{4}$ of this book to the warm-blooded vertebrates. Birds and mammals have a prominent place in the interest of any student of natural history.

CLASS AVES. THE BIRDS

Since birds are warm-blooded, they maintain an approximately uniform body temperature independent of that of their environment. In this they differ from cold-blooded animals, considered to be more primitive. All birds lay eggs, which are usually incubated by either or both of the parents. The longer the incubation period, the more likely is the young bird to be well developed or *precocial* when it hatches. In this type of bird, the egg is relatively large and parental care of the young relatively poor. In *altricial* birds where the eggs are small, the young helpless, and the incubation period short, parental care is essential to survival. The parts of a bird are illustrated in the diagram below. The number given after the common or scientific name in the following pages is the American Ornithologists' Union check list number.



CLASS MAMMALIA. THE MAMMALS

Like the birds, the mammals are warm-blooded. Their bodies, instead of being covered with feathers, are more or less covered with hair. The structure of the hair of different mammals and even of races of different species of mammals may be used for identification purposes. Through the courtesy of Dr. Leon Hausman, the nature of some of these hairs is indicated in the following pages.

Also important in the identification of mammals are the nature and arrangement of the teeth on the jaws. Through the use of a simple formula, this condition can be quickly indicated for the different species. Beginning at the front of the human jaw and going to the rear on one side, one finds first cutting or incisor teeth, indicated in a formula by *I*. In man, the formula

would read $I \frac{2}{2}$, meaning that there are 2 incisors

on each side on each jaw. In man, the next teeth are single, pointed canine teeth, 1 on each side on each jaw. The formula therefore continues

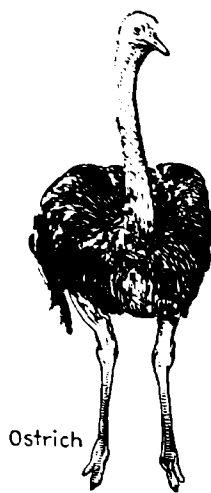
as $C \frac{1}{1}$. 2 bicuspid teeth behind the canines on

each jaw add to the formula $B \frac{2}{2}$ (or premolars,

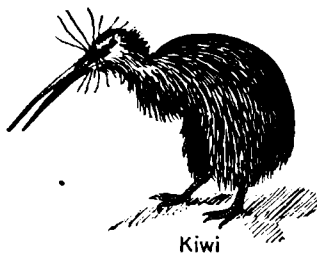
$P \frac{2}{2}$). Behind these are 3 molars, completing

the formula with the unit $M \frac{3}{3}$. Using this same technique we may quickly find the nature of the teeth of any mammal.

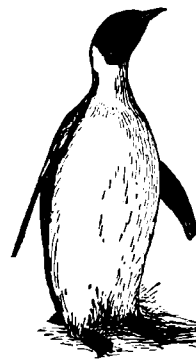
Tracks or pugs are often indicative of the presence of mammals. For this reason, we have included the tracks of several for your assistance. Hind-foot tracks are indicated by the letter *H* and fore-foot marks by the letter *F*. The direction taken by the animal is indicated by an arrow and the approximate size or stride by appropriate measurements. In the "track formula" used $F 1 \times 2, 5$ means that the track of the front foot measures 1 by 2 in. and that the foot has 5 toes. *H* refers to the hind foot, *Sp* to the spread between paired tracks, *St* to the stride, and *L* to the leaping distance. We regret the omission of *scats* or droppings, so useful in recognizing the presence of mammals.



Ostrich



Kiwi



Penguin

PHYLUM CHORDATA. CLASS AVES

Order Struthioniformes Family Struthionidae

Ostrich

1. *Struthio camelus* (Northern)
2. *S. australis* (South African)
3. *S. molybdophanes* (Somaliland)
4. *S. meridionalis* (Masailand)

Male to 8 ft. high. Weight to 200 lb. Body plumage black, but tail feathers and wing quills white. Female smaller, dusky gray. Both sexes with down on long neck, short broad beaks, and 2-toed powerful feet. Bare parts of legs of (1), pink; of (2), bluish; of (3), lead-colored. Vision excellent. Shy.

Over a wide range of desert area, from Arabia to South Africa, in open sandy stretches; now grown rather commonly in ostrich farms and protected in sanctuaries in Africa, South America, and southern California. One of largest farms near Los Angeles. Often in flocks in wild.

Eggs of (1), smooth; of (2), rough. One cock mates with 4 or 5 hens, which lay their eggs in common nest hollowed in sand. Eggs 12-20, each weighing 2-3 lb., hen laying every other day. Incubation 40 days; hen, by day; cock, by night. In captivity, may lay again soon if chicks are removed. Life span to 70(?) years.

Food, a variety of plant and animal matter mixed with stones, including mammals, reptiles, birds, fruits, and grass. Can run faster than horse, making 12-ft. strides when pursued, commonly running in circles. Does not avoid danger by hiding head in sand as commonly reported. Fights effectively with powerful feet and legs.

Eggs and flesh, used as food by men in native land. Plumes of value in millinery and arts, a young bird yielding feathers at 18 months and a mature bird yielding 3 crops of feathers in 2 years, worth annually around \$30(?). Mentioned in Job 39:13-18. Considered a delicacy by early Romans. Temperature, 99-104°F.

Order Apterygiformes Family Apterygidae

Kiwi

1. *Apteryx australis* (South Island)
2. *A. mantelli* (North Island)
3. *A. owenii* (Gray)

Length: (1), about 2½ ft.; (2), about 2 ft.; (3), about 1½ ft. Female of (2), about 5 in. longer than cock. Color: (1), gray-brown; (2), reddish-brown; (3), gray-brown with crossbars of black. All have loose plumage, long bills, and are flightless. Toes 4, with strong claws. No noticeable wings or tail.

Native of New Zealand. Since they are flightless, they of course live on the ground. Different islands have developed different species, as indicated by the common names given above. They are more closely related to ostriches than to other birds but even this relationship is not close.

Nest is usually placed at foot of some tree. Hen lays a single creamy-white egg larger than would normally be expected of a bird her size. Nest is usually in a hole and therefore well-hidden. Young closely resemble adults. Courtship is marked by *kiwi* call that gives bird its name.

Nocturnal. Food largely insects and their larvae, worms, snails, and similar small animals gleaned with help of long bill. Nostrils are at extreme end of long beak. Has ability to run with exceeding swiftness, reflected in long legs, huge thighs, and leg muscles.

Rather well-known largely because of its inability to fly, its limited range, and other characteristics that have gained it a place as a bizarre and an interesting animal in literature if not in our own backyards. Its food would imply that it was useful.

Order Sphenisciformes Family Spheniscidae

Penguin

1. *Aptenodytes* sp. (Emperor and King)
2. *Eudyptes* sp. (Royal)
3. *Pygoscelis* sp. (Gentoo)
4. *Spheniscus* sp. (Jackass)

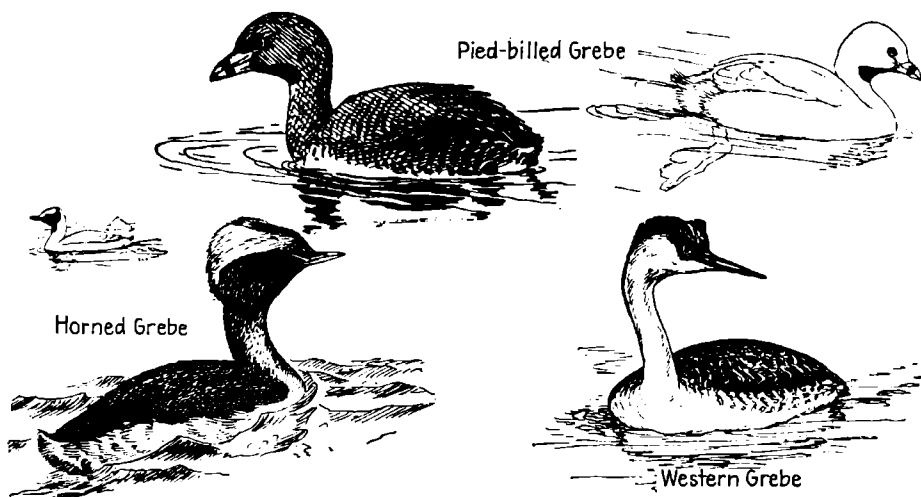
(1) over 3 ft. long, with orange and yellow patches on sides of neck. (2) to 30 in. long, with orange on sides of crown above eyes. (3) to 30 in. long, with red bill, 6-in. tail and orange feet. (4) to 27 in. long, with gray-mottled black feet, black bill with gray bar; short tail of 20 feathers, narrow black horseshoe on breast.

(1) breeds on Antarctic ice barrier, Tierra del Fuego, Tasmania, New Zealand; (2), south of New Zealand and Tasmania; (3), from Antarctica to Tasmania and New Zealand; (4), coasts of South Africa. Penguins are essentially birds of Southern Hemisphere, the 20-in. Galápagos penguin ranging just north of equator and being only penguin restricted to tropics.

Penguins usually breed in great colonies, the king and emperors laying only 1 egg, which is incubated on feet under brood flap, on ice barrier in total darkness of antarctic winter. Other penguins brood eggs much as do other birds. Royal penguin egg is pale blue, granulated, 3 by 2½ in.; incubated by both parents, and young take to sea with colony at 3 months.

Penguins feed almost exclusively on fish and other marine animals captured by expert swimming and diving, young being fed partly digested crustacea from gullets of parents. Molting is done on shore either before or after breeding, and new set of feathers is completed in a few days or weeks. At rookeries, penguins are noisy, hence the jackass penguin's bray.

Penguins are of considerable economic importance as producers of oil and guano and are protected for this in some rookeries; 150,000 killed a season in one New Zealand rookery without decreasing population. Their harvest is being regulated and should be controlled by international law to prevent depredations by lawless nations.



PHYLUM CHORDATA. CLASS AVES
Order Colymbiformes. Family Colymbidae. THE GREBES

Horned Grebe, 3
Colymbus auritus

Length $13\frac{1}{2}$ in., wing $5\frac{3}{4}$ in., bill $\frac{9}{10}$ in. In summer head, throat, lower side of head, back of neck are black with conspicuous buff ear tufts; back, gray; under parts, white; breast and sides, brownish. In winter sharply contrasting dark gray and white—white on cheeks, under parts, and neck being most conspicuous. Young like winter adults.

Breeds from Arctic Circle south to southern British Columbia and Maine, in Iceland, northern Europe, and northern Siberia. Winters south from Maine and southern Alaska, to Florida and southern California, northern Africa, along coasts of China and Japan, occasionally in Bermuda and Greenland. Known from Pleistocene times.

Nest of water-soaked floating vegetation, in shallow water. Eggs 2-7, dull dirty white, $1\frac{3}{4}$ by $1\frac{1}{4}$ in. Incubation about 21(?) days, with both parents attending downy young, which quickly learn to swim and dive when hatched; even prematurely hatched chicks swim readily and well. Chicks at first streaked and spotted.

Food: of 57, 23% beetles, 12% other insects, 27.8% fish, 20.7% crayfish, 13.8% other crustaceans, with remainder miscellaneous animal matter. Most stomachs had feathers. Obviously not a serious enemy of fishes. Migrations in flocks appear off Atlantic Coast in October-November and in March-April, flying high or low.

Interesting as a past master of art of swimming and diving. Because of position of legs and their nature, entirely helpless on dry ground where it sometimes comes to rest during periods of migration. Reported to use wings occasionally in swimming under water. A water sprite if ever there was one.

Pied-billed Grebe, 6
Podilymbus podiceps

Length to $13\frac{1}{2}$ in., wing $5\frac{3}{4}$ in., bill $\frac{9}{8}$ in. Glossy brownish-black above with black throat; brownish on sides of body and neck; whitish on belly and lower breast; bill gray, black-banded. Young and winter adults with white throat and no bill band. Feet with broadly lobed webs, greenish to black. Legs placed far back. No evident tail.

Common along lake shores and shallower ponds in most of North America, breeding from British Columbia to Nova Scotia and south to Florida and Mexico. Winters New York to southern British Columbia south, with related races in South America. Differs from eared grebe by presence of brown breast and absence of white wing patch.

Nest a floating mass of soaked vegetation among plants. Eggs 4-8, soiled dull white, $1\frac{3}{4}$ by $1\frac{1}{2}$ in., covered with vegetation when parent is absent. Incubation 21 days. Young down-covered when hatched; able to swim and dive shortly after hatching. 1 annual brood protected by parents until independent.

Food essentially fish and other aquatic animals captured usually by diving and pursuing under water. Practically helpless on land and unable to take to air except from water surface. Call a loud cuckoo-like *cow-cow-cow* and a ridiculous series of other calls.

Probably of some importance in determining existence of fish but grebes are rarely abundant enough to be a serious menace anywhere. Flesh unpalatable. Dives almost too quickly to be killed except by expert marksman.

Western Grebe, 1
Aechmophorus occidentalis

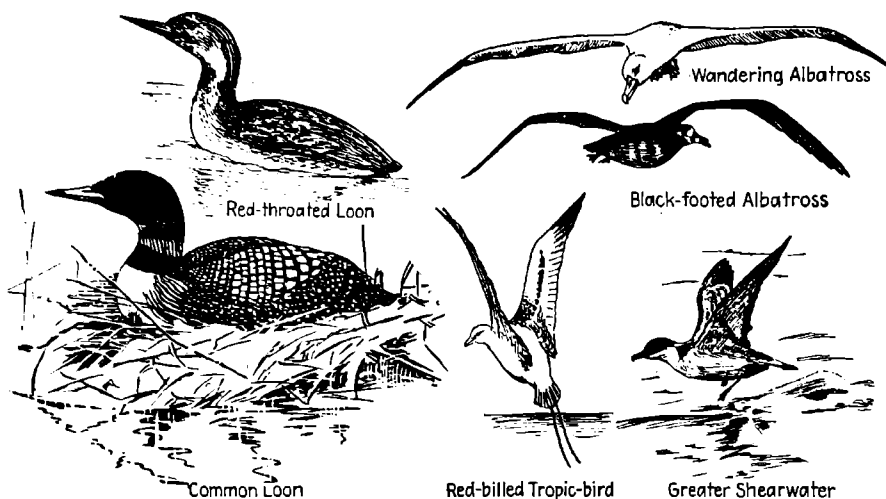
Length to 29 in., including 3-in. bill and short tail. Conspicuously black and white winter or summer, young or old, with exceptionally long slender neck. Black on top of head, back of neck, and back. Yellow on bill, and white on under parts, cheeks, and neck. No birds in its range with which it can be easily confused in summer. Female smaller.

Breeds from Washington, southern Saskatchewan, and southern Manitoba to southern California, Utah, and northern North Dakota. Winters from southern British Columbia through California to Lower California and central Mexico but occasionally found east to Ontario, north to Alaska, and at intermediate points.

Nest near water's edge, or a floating raft of vegetation. Eggs 3-10, $2\frac{3}{4}$ by $1\frac{1}{2}$ in.; dull bluish-white, cream, or olive-brown; generally stained. Nesting period May. Downy young light gray above, white on belly, with triangular naked spot on crown. Young take to water and swim almost as soon as out of egg, but often ride on parents' back.

Food probably mostly fish and other small aquatic animals, though few studies have been made. Fish, beetles, seeds, and feathers of bird itself have been found in crops of the few that have been examined carefully. Can dive at flash of gun and remain under water a long time. An admirable swimmer but helpless on land.

Formerly western grebes were killed by thousands by plume hunters, who used their densely feathered breasts as highly durable ornaments for hats.



PHYLUM CHORDATA. CLASS AVES
Order Gaviiformes
Family Gaviidae

Order Procellariiformes
Family Diomedidae

Common Loon, 7
Gavia immer

Length 32 in., wing 14 in., bill $2\frac{1}{2}$ in. Black above, with white breast and belly, and with white bars on back. Young and adults in winter, with gray between black and white, instead of being white-spotted on wings. Legs placed far back. Feet with 4 webbed toes. Powerful swimmer.

Breeds Labrador to northern Illinois, in New York, Pennsylvania, New Hampshire, Connecticut, South Carolina, Mississippi, Norway, the Shetland Islands, and southeastern Canada. Winters Great Lakes and Nova Scotia to Florida and Gulf Coast and from British Isles to Azores, the Mediterranean and Black Seas. Others to the west.

Courtship by violent diving, bowing, and calling. Nest of loose plants or nothing, on shore. Eggs 2, olive-brown or gray, with thin black spots, $3\frac{1}{2}$ by $2\frac{1}{2}$ in. Incubation 29 days. 1 annual brood. Young down-covered when hatched; soon able to swim and dive. May be 3-4 years before adult plumage is attained.

Food, fish, almost exclusively caught by pursuit under water; one reported to have been caught in a net anchored at depth of 200 ft. Loses flight feathers in late summer. Flight direct and swift but cannot be started except from water. Migrates high, singly or in flocks.

Most interesting inhabitant of wilder inland waterways and seashores. Probably does some damage in destroying fish, but numbers are so small that this can hardly be considered serious. Should not be allowed to become extinct. May seem more abundant than they really are because of winter concentrations.

Red-throated Loon, 11
Gavia stellata

Length to 27 in., including 2-in. tail and $2\frac{1}{4}$ -in. bill. Wingspread to 4 ft. Sexes colored alike. In spring, head and neck gray; throat with conspicuous chestnut triangle at lower edge, white beneath, fore breast striped with black and white. In winter dusky above, with small white spots, and white below.

Breeds northern Alaska and western Aleutians to Greenland and south to northern British Columbia, southeast Quebec, and Newfoundland; also in Arctic Europe and Asia. Winters from Aleutians to northern Lower California, and from Gulf of St. Lawrence to Florida. Sometimes in Montana, Kansas, Missouri, Nebraska, Iowa, and Idaho.

Nest near lakes and ponds, on shore, usually making no nest but sometimes lining a shallow depression with grasses. Eggs 2, 3 by $1\frac{3}{4}$ in.; highly variable in color, spotless or with dark-brown spots over drab. Incubation to 28 days, by both sexes. Some young birds are more spotted than adults. Downy young dark gray above, and drab.

Food primarily fish caught by diving and pursuing under water. This species suspected of eating fish eggs. Cannot take off from land. Those that come to earth in migration usually die. In migration, groups are kept together by weird cries somewhat resembling goose's honk and yet like call of common loon.

Probably is not useful because of its food habits but it contributes much to "wildness" of area in which it is found. For this reason is entitled to protection. A summer spent in north country without hearing or seeing a loon is practically a total loss. New England migration is at its height in October.

Black-footed Albatross, 81
Diomedea nigripes

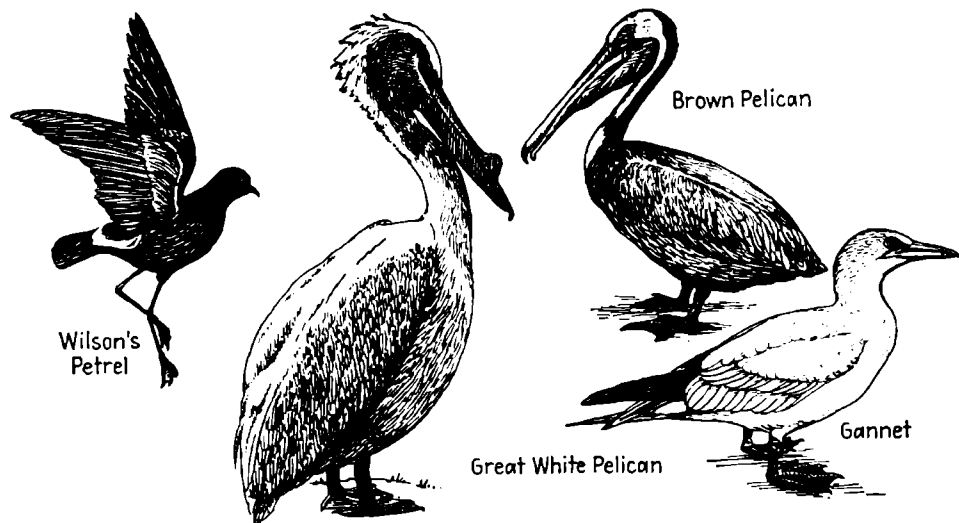
Length to 32 in. Wingspread to 7 ft. Wings narrow and saber-shaped. Bill dusky. Feet and legs black. Dark above and below, with rump dark or rarely dirty white and neck region sometimes lighter. Easily distinguished from gulls because of longer, relatively narrower wings.

Over Pacific Ocean north of Tropic of Cancer but sometimes to equator, from Alaska to Lower California south to Formosa on Asiatic coast. Many relatives, particularly in the South Pacific. This species breeds in smaller Pacific Islands conspicuous in World War II including Midway, Bonins, Marshalls, and so on. Many breeding colonies destroyed by men in need of food.

Nests of albatrosses are usually simply depressions in the ground or in a hollow atop a slight mound. Eggs are laid 1 to a nest and young when hatched are helpless, sooty brown, and covered with soft down; exhibit relatively slow growth.

Albatrosses famous in Coleridge's "The Ancient Mariner," as followers of ships at sea. Ordinarily are not seen close ashore on our mainland. They feed largely on fish. To take flight, they require a considerable area to get a running start. They can settle their bodies under water.

Have been used as food by men cast adrift and can be caught with baited hook and line. Their wing bones have been used as pipestems and skin of their feet has been used for making unique sacks. Welcome sight to most who sail the seas, either in time of trouble or otherwise.



Order Procellariiformes

Family Hydrobatidae

Wilson's Petrel, 109 *Oceanites oceanicus*

Length to $7\frac{1}{2}$ in., including $3\frac{1}{4}$ -in. tail and $\frac{1}{4}$ -in. bill. Wingspread about 16 in. Sexes colored alike. Dark brownish-black above and lighter beneath; with a conspicuous white curved patch at base of square-tipped tail and with fainter narrow lighter band near rear edge of wing bases. Feet yellow and webbed. Leach's petrel has forked tail and lighter wing bands.

Breeds in Southern Hemisphere on Mauritius and Kerguelen Islands, Adelie Land, South Victoria Land, South Shetland, South Orkney, and South Georgia Islands. Found in all oceans, except Pacific north of equator. Spends summer in North at sea unless blown ashore by storms. Commonly seen in North Atlantic in summer at least 10 miles offshore.

Nests on ground, usually in or near rock crevice, with or without plant-material lining. Eggs, 1, $1\frac{1}{5}$ by $\frac{9}{10}$ in.; white with fine purplish or red-brown spots around larger end. Usually nests December-March. Incubation 35 days, by male, breeding and nesting period lasting about 5 months. Annual molt May-October, in North.

Food largely oily fish wastes. Because of this, are common in wakes of fishing vessels far at sea. Known also to eat small crustaceans, fishes, some insects, and some seaweed. Conspicuous because of rather long dangling black legs and yellow feet. Because of wide range, cannot be used as indicator of nearness of land.

Usual schedule: May-June, generally inshore along Atlantic Coast of North America but never north of Labrador on American coast or of 57° N.L. on European coast. Leaves American coast about September. During February and early March, found no place north of equator. Called "Mother Carey's Chicken."

PHYLUM CHORDATA. CLASS AVES

Order Pelecaniformes

Family Pelecanidae

White Pelican, 125 *Pelecanus erythrorhynchos*

Length to 5 ft., wing 22 in.; bill 14 in. with huge pouch beneath and horny prominence above during breeding season. White, with black wing quills. Flies with hunched head. Brown pelicans have top of head white, neck brown, back silvery gray, and side silvery.

White pelican breeds from British Columbia to Wisconsin and southern California; winters, northern California, sometimes to Pennsylvania and south to Trinidad. Brown pelicans (2 species) breed from South Carolina and northern California south to northern South America, wintering farther south. Known from Pleistocene times.

Nest of white pelican on ground in a depression. Eggs 2-4, creamy or blue-white, stained and chalky-marked; $3\frac{1}{2}$ by $2\frac{1}{4}$ in. Incubation 29-30 days. Eggs of brown pelican 3 by $1\frac{3}{4}$ in. Young feed from bill pouch of parent, almost burying head in throat region when feeding. Nests usually in large colonies.

Food almost exclusively fish. White pelican catches food by swimming with bill pouch submerged. Brown pelican catches food by diving spectacularly from air into water. Feeds and flies in flocks, the white in breeding season often soaring out of sight. Usual flight formation, a diagonal line with flight direction. Speed, 30 m.p.h.

Controversy over economic importance of pelicans, fishermen claiming they are destructive. Since their numbers are small this is probably not serious. May range 50 miles from base in feeding activities. White pelicans migrate by day, in great high-wheeling flocks. Brown pelican, State bird of Louisiana.

Family Sulidae

Gannet, 117 *Morus bassana*

Length to 40 in., including 10-in. tail and 4-in. bill. Wingspread to 6 ft. Adult sexes alike in appearance. Body mostly white. Head and neck yellow with a dark-blue area of skin showing on throat. Bill white. Feet black. Young dark gray-brown above with white spots and white beneath. Wing tips black. Wings relatively slender.

Breeds on rocks of Bonaventure and Anticosti Islands in mouth of Gulf of St. Lawrence, off southeastern Newfoundland, and on British Isles and Iceland. Winters from coast of Virginia to Cuba and Vera Cruz, on the coasts of Africa, Azores, and Canary Islands. Accidentally found inland to Michigan.

Courtship dance is engaged in by both sexes. Nests in large colonies. Nests absent, or a well-made nest of vegetation, usually on cliffs. Eggs, 1, 3 by 2 in.; blue-white, overlaid with stained or unstained lime deposit. Nests May-July. Incubation 38-42 days by both sexes; 1 annual brood. Newly hatched young naked, almost black, and helpless.

Food, fish captured by diving; may take a direct plunge from height of 60-140 ft. in air and go under water to depth of 90 ft., probably using wings to help movement under water. Has difficulty in rising from a perfectly calm sea. Accepted at sea as being within 100-300 miles from land and usually seen in groups of 3 or more.

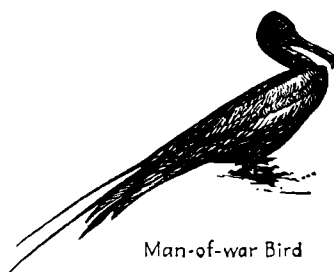
Known to eat herring, mackerel, cod (up to 2 lb.), salmon, smelt, anchovy, and cuttlefish but is useful to fishermen in locating schools of fish and their depth. Not considered as serious enemies of fishing by most people. Only gannet found on shores of North America. Most numerous in May and June between Cape Race and Cape St. Mary.



Double
Crested
Cormorant



Water Turkey
Anhinga



Man-of-war Bird

PHYLUM CHORDATA. CLASS AVES

Order Pelecaniformes

Family Phalacrocoracidae

Double-crested Cormorant, 120 *Phalacrocorax auritus*

Length 35 in., wing 12½ in., rail, 6½ in., bill, 2½ in. Tail feathers, 12. Black head, neck, rump, under parts, and tail. Naked throat pouch dull orange. Black tufts on either side of head, over eye in breeding season. Common cormorant has 14 tail feathers and is larger, with white bordering orange throat patch.

Breeds Newfoundland to central Alberta, south to Nebraska and Maine. Winters from Virginia to Gulf Coast and in Bermuda. Commonest eastern cormorant and is seen in flocks or singly far inland during migration. Haunts pilings in great numbers around Florida and Gulf Coast in winter. Known from Pleistocene times.

Nest of sticks or weeds, crudely arranged on cliff, bushes, ground, or in trees. Eggs 2-4, pale blue-white with a chalky deposit, 2½ by 1½ in. Incubation 28-29 days. Young naked, black, and shiny when hatched, but soon with black down. A fall molt and a partial spring molt, with molting rather constant until mature at 2 years.

Food almost exclusively fish caught by diving, sometimes using wings to assist in getting speed under water. When flying from perch, it usually descends first almost to water. Flies in long lines in migration. When resting on water, resembles loon but lacks white coloration. Temperature 106°F. Speed 20 m.p.h.

Considered an enemy of fish by many fishermen. Taverner contends that fish eaten are commonly of no economic importance or are real enemies of valuable species. Interesting because of habits about harbors, where it is known as a "shag." Relatives used by Chinese to capture fish, by putting ring around throat and keeping bird on a string over fishing grounds.

Family Anhingidae

Water Turkey, 118 *Anhinga anhinga*

Length to 34 in., including neck and bill, which are about ⅓ total length, and tail, nearly another ⅓. Body slender. Male green-black and glossy with gray-flecked head and neck, silver-spotted back, silver-gray spotted wings with wide white band, and white-tipped tail. Female like male but darker above, and with pale buff head, neck, and breast.

Breeds through tropical America from Bexar County, Tex., to North Carolina, south to southern Brazil, Paraguay, and northern Argentina. Winters from Yuma, Calif., through central Arkansas to South Carolina and south. Has been found north to Ohio. Found in or near swamps and large streams.

Nests in swamps and bayous, on bushes or small trees overhanging water. Nest a large, poorly constructed, cumbersome mass of sticks, grasses, mosses, and leaves. Eggs 2-5, 2½ by 1½ in.; whitish, greenish-white, grayish-green, or bluish-white, and usually with a generous crusting of limy material on outside. Commonly nests in rookeries, near herons or ibises.

Food mostly fish and other aquatic animals, fish often caught by pursuit under water and held by finely toothed edges of long pointed bill. Feet webbed. May soar high in air like hawks, or may sink into water gradually until only tip of bill remains exposed. 4 species of water turkeys known in world.

Interesting bird of seacoasts, tropical swamps, and waterways. Probably does some damage to fish but is rarely abundant enough to be considered as serious pest. Always interesting as "snakebird," or "darter" to those who may not be familiar with it.

Family Fregatidae

Man-of-War Bird, Frigate Bird, 128 *Fregata magificens*

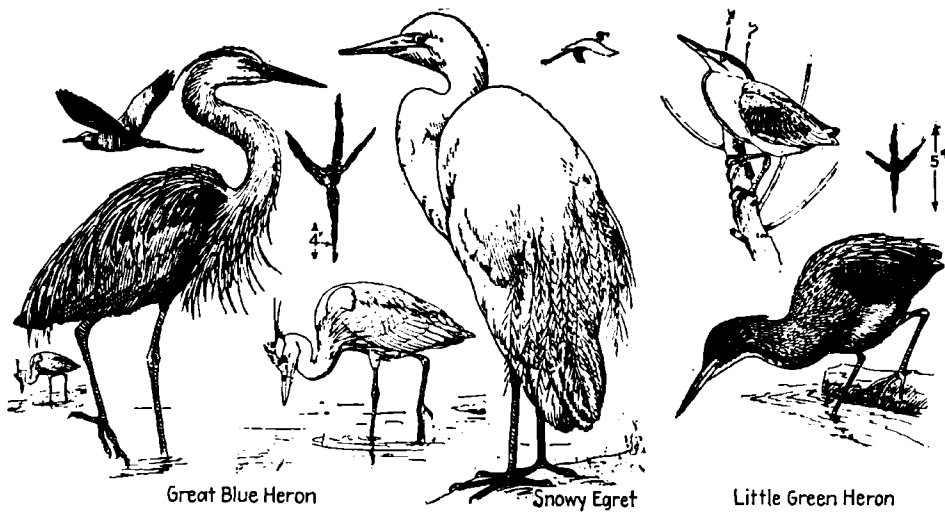
Length to 41 in., including 6-in. bill and 19-in. tail that is forked for more than ½ its length. Wings long, slender, and conspicuously angled forward. Adult male black, with duller belly, and with greenish-bronze and purple cast. Female less glossy. Immature, with white head. Does not always show forked tail in flight.

Breeds West Indies, Bahamas, and islands off coast of Venezuela in the Caribbean, and along Mexican coast and Galápagos Islands. Winters in breeding area but may make way north to Humboldt Bay on California coast, to Nova Scotia on Atlantic Coast, or even inland to Wisconsin, Illinois, and Ohio. 1 species widespread in Indian Ocean. 5 species recognized.

Breeds in colonies. Nest of sticks and flimsy plant material, carelessly put together on low trees or bushes, usually a few feet from ground. Eggs 1-3, 2½ by 2 in.; white. Nests February-May. Incubation by both parents. Young naked when hatched, but soon covered with a white down. Juvenile plumage holds for first year.

Food, fish picked up at or near surface of ocean, or flying fish. Almost helpless on land but a master of the air. A bird with a body size of a red-tailed hawk and wings stretching to 8 ft. It can pester pelicans and boobies, forcing them to surrender food they have captured. It is pugnacious enough to attack even the heavier osprey.

Marvelous flier. Has a strong homing instinct and has been used by man to carry messages like carrier pigeons for 60-80 miles. Does not migrate regularly. Never sleeps on water and is usually found within 75 miles of land, so direction of flight at dusk may be an indication of location of land. Any group of half-dozen birds would probably be within 75 miles of land.



PHYLUM CHORDATA. CLASS AVES
Order Ciconiiformes. Family Ardeidae. THE HERONS

Great Blue Heron, 194
Ardea herodias

Length 50 in., wing 20 in., bill $6\frac{1}{4}$ in. Legs and neck long and slender. General color pale-slate-gray, with crown and center of throat white, bend of wing chestnut, breast black and white streaked, legs and feet black. Young with crown black and bend of wing paler.

Breeds Nova Scotia to southeastern British Columbia to Nebraska, South Carolina, and Bermuda. Winters from Oregon and New York south to Florida, Venezuela, Colombia, and Panama. Haunts marshes, lake margins, rivers, and small streams. Nests and roosts in colonies either in rushes or in trees. From Pleistocene of Florida, Oregon, and California.

Nest a platform of sticks, which may be used many years. Courtship largely by display in a circle. Eggs 3-4, pale dull blue, $2\frac{1}{2}$ by $1\frac{1}{2}$ in. Incubation 28 days. Young scrawny, more or less helpless at first, but by July in northern part of range are feathered and able to fly. Fed at first by violent regurgitation activity.

Food fish, sometimes to 1 ft. long, water snakes (enemies of fish), grasshoppers, crayfish, mice, frogs, shrews, and other small animals. Food caught by lightning-like thrust of beak. Can rest on deep water and take to flight from floating position. Flight slow (28 m.p.h.), steady, and remarkably beautiful. Probably deserves protection.

Exact economic importance not determined but bird is protected by law in many states and is rarely so abundant that it could cause serious damage even if its food were solely valuable species of animals, which it is not. Most of fish eaten are of little economic importance and beauty of bird is worthy of preservation.

Snowy Egret, 197
Leucophoyx thula

Length 24 in., wing $9\frac{3}{4}$ in., bill $3\frac{1}{2}$ in. Legs and bill black, feet, yellow. Elsewhere white, with some 50 recurving plumes on back during breeding season. American egret larger (41 in.) and has black feet, legs and bill. Young of little blue heron (22 in.), white with slate wash and dark feet.

Formerly bred from New Jersey to Nebraska and south to Chile and Argentina; now in United States, along coast from North Carolina to Texas. Winters from Florida and Mexico south. Has late-summer northern migration to Alberta and Nova Scotia preceding winter southern migration. Known in Florida from Pleistocene times.

Courtship by strutting and pursuit. Nest, in colony, of coarse sticks in bushes over water. Eggs 3-5, pale dull blue, $1\frac{1}{2}$ by $1\frac{1}{2}$ in. Incubation 8 days. Young helpless awkward creatures when hatched; reared by both parents, which at time bear plumes in their prime. Young leave nest in 3 weeks. 2 molts annually.

Food: 50 meals of young included 120 small suckers, 762 grasshoppers, 91 cutworms, 29 crayfish, 7 water moccasins, and 2 lizards. Food may also include seeds of some aquatic plants. Rushes its prey and darts after it more actively than most herons, sometimes running into water up to wings while pursuing fishes. Speed, 17 m.p.h.

Probably essentially useful and no doubt one of most beautiful of all birds. Formerly killed in great numbers for millinery trade, $1\frac{1}{2}$ million being shipped in 1 year from Venezuela alone. Now protected by law and sale of their plumes outlawed in United States. Saved from extermination largely by Audubon Society.

Green Heron, Shitepoke, 201
Butorides virescens

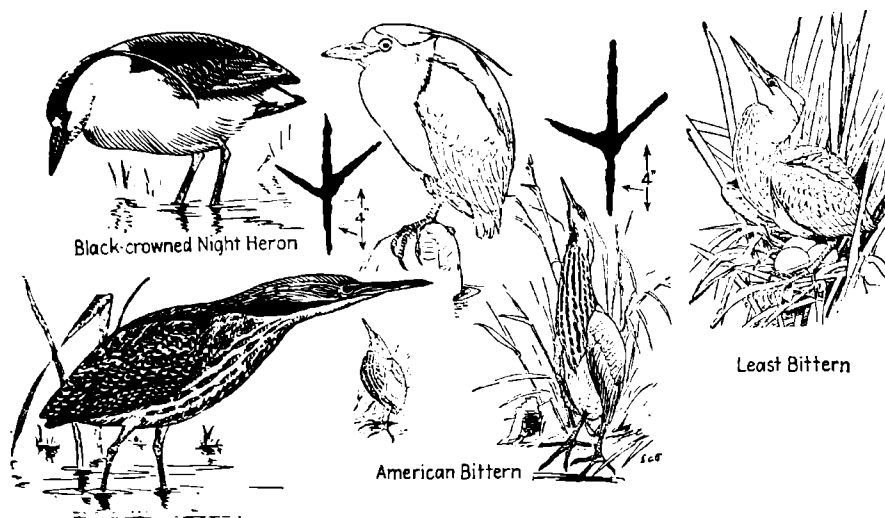
Length 17 in., wing $7\frac{1}{4}$ in., bill $2\frac{1}{2}$ in. Dark-colored with comparatively short yellow or orange legs. When excited, elevates a shaggy crest. Greenish-black on crown and in line below eye, neck rufous, belly ashy, remaining general color at a distance gray. Young with black-streaked necks.

Breeds North Dakota to Nova Scotia, south to New Mexico, Texas, Mexico, Guatemala, northern Honduras, Gulf Coast, Dry Tortugas. Winters Florida and southeastern Texas to Central America and northern Colombia. Occasionally in Bermuda, Haiti, and Puerto Rico. About rivers and other waterways. Known from Pleistocene.

Nest a platform of sticks, in low trees or shrubs over water. Nests in scattered colonies 3-20 ft. or more above ground, or singly. Eggs 3-9 (sometimes 2 females laying in 1 nest), pale blue, $1\frac{1}{2}$ by $1\frac{1}{2}$ in. Incubation 17 days. Young gain $\frac{1}{2}$ oz. daily first 6 days, soon climb from nest with beak and feet.

Food insects and other forms of small animal life including grasshoppers, crickets, worms, fish, snakes, and even small mammals. Feeds usually early morning and late afternoon. Called "shitepoke," "chalkline," "fly-up-the-creek," "skeouw" from behavior or call. May plunge into water for food occasionally. Speed, 34 m.p.h.

Of no value as food to man and of little if any damage to his interests, so is worthy of protection. Its slow flight makes it a tempting shot for amateur hunters but dead bird is worthless while live bird has value as part of its environment.



Black-crowned Night Heron

Least Bittern

American Bittern

PHYLUM CHORDATA. CLASS AVES
Order Ciconiiformes. Family Ardeidae. THE HERONS

Black-crowned Night Heron, 202
Nycticorax nycticorax

Length 24 in., wing 12 in., bill 3 in. Forehead, sides of head, under parts, and neck pale gray. Crown, upper back, and wings glossy greenish-black. Lower back, wings, and tail ash gray. Legs and feet yellow. With 3 white 8-in. plumes back from top of head. Young gray-brown above, and under parts white with black streaks.

Breeds from northern Oregon to Nova Scotia, south to Patagonia. Winters from northern California to New York or sometimes New England and New Brunswick, south to Patagonia, with a closely related race in Old World. Common in trees and rushes about waterways. Known from Pleistocene of Florida and California.

Nests in great colonies, female often courting male. Nest a platform of sticks, (sometimes 8 nests in a single tree), poorly lined with fine material. Eggs 3-6, pale dull blue, 2 by 1 3/8 in. Incubation 24-26 days, by both parents. Young practically helpless, cared for by parents in first 3 weeks, or until half-grown.

Food about 80% fish, often taken at night, many being already dead. 50 meals of young included 60 crayfish, 610 catfish, 31 other fish, and 79 dragonflies. Flight to and from feeding and nesting ground, evening and morning, marked by "squawk." Young wander about considerably in fall months.

Young birds considered edible by some persons, but not commonly eaten. Principal enemies are crows and raccoons. In flight, resembles a slow-flying, long-legged, light-colored crow, night flights being recognized by calls. Commonly protected by laws as migratory birds. Not considered edible as adults. Temperature, 102-106.8°F.

American Bittern, 190
Botaurus lentiginosus

Length 28 in., wing 10 1/2 in., bill 3 in. Top of head and back of neck, slate, with glossy black streak on each side of upper neck. Back brown. Under parts creamy, with appearance of brown streaking. Young appear somewhat redder. When approached, holds beak erect and fluffs out feathers toward enemy.

Breeds from British Columbia to southern Ungava and Newfoundland, to southern California, Kansas, and southern New Jersey. Winters British Columbia to Indiana and south to Guatemala, Cuba, Jamaica, Puerto Rico. In fall, may move north to southern Alaska. Occasionally in Greenland, Iceland, and Great Britain. Known from Pleistocene times.

Elaborate courtship display. Nest, platform of marsh plants among rushes. Eggs 3-5, pale grayish or brownish-olive, 1 1/10 by 1 1/2 in. Incubation 28 days. Young helpless at first with long buffy down; remain in nest about 2 weeks, cared for by both parents. First plumage appears at 10 days. Matures second autumn.

Food varied, including meadow mice, snakes, lizards, salamanders, frogs, crayfish, grasshoppers, dragonflies, and other forms of small animals caught by lightning-like thrust of beak while bird stands awaiting approach of meal. "Stump-knocking" sounds of male produced by convulsive movements of whole bird. Flight slow, deliberate, powerful.

Probably of neutral importance economically. Protected by law because of unique character and because territory occupied is not normally considered economically valuable. Numbers never great enough to make species dangerous in any way to man's interests. Temperature, 103.7°F.

Least Bittern, 191
Ixobrychus exilis

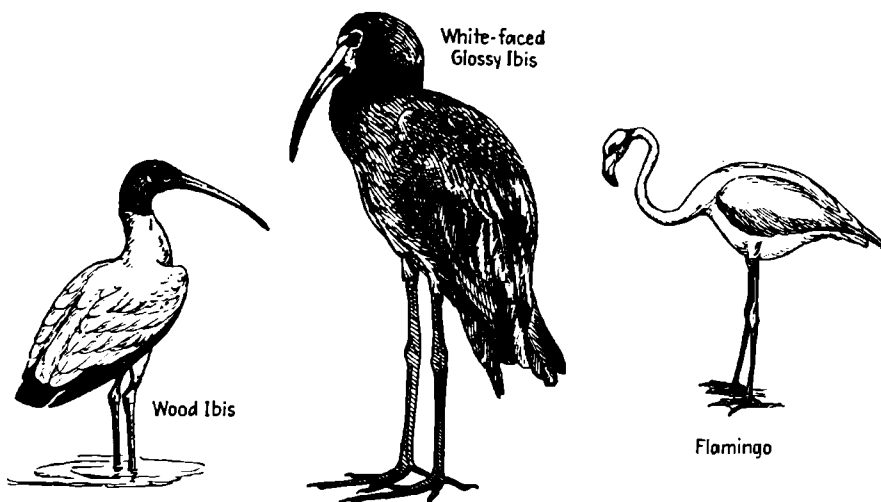
Length 11-14 1/2 in. including 2-in. beak and 2-in. tail. Wingspread to 18 in. General appearance brown, but small for a heron. In flight shows large light brown patches on wings and a conspicuously black back, tail, and crown. Flight awkward, labored, and not long sustained. Female and young browner on back.

Breeds from southern Quebec to southern Maine and south through North Dakota to southern Mexico and West Indies. Winters from Georgia to Texas and south to eastern Guatemala. 2 subspecies: eastern described above and western ranging from Oregon to central Lower California and western Guatemala.

Nests in marshes and swamps. Nest a flat platform of reeds or twigs, in low bushes or reeds or rarely in trees, well-hidden. Eggs 3-6, 1 1/8 by 1 in.; bluish or greenish-white. Incubation 17 days or less, by both parents, with 1 brood in North and possibly 2 in South.

Food probably mostly insects and other small animals of marshlands. Hides with remarkable skill in trees, brush, or reeds. When frightened, flies only a short distance. Call a soft repeated coo. Migration is at night, silent and relatively low, with result that bird is often injured.

Not sufficiently abundant to be of economic importance. Interesting because it is such a small bittern. Corey's least bittern is a rare color phase of this species, differing from it in having light buff replaced by deep chestnut.



PHYLUM CHORDATA. CLASS AVES
Order Ciconiiformes

Family Ciconiidae

Wood Ibis, 188

Mycteria americana

Length to 4 ft., including 7½-in. tail and 9½-in. bill. Wingspread to 5½ ft. Weight, male to 11¼ lb.; female to 9¼ lb. Large, white, heron-like. Head and neck of adults bare, covered with dark heavy wrinkled skin. Tail glossy black, wing tips black, otherwise white. Bill long, stout at base, and gradually bending downward.

Breeds along Gulf Coast from Texas to Florida and north to South Carolina, with some in West Indies, Mexico, and South America, on to central Argentina and Peru. After breeding season, migrates widely to central California, Montana, New Brunswick, and intermediate points. Found mostly in swampy areas, particularly in cypress swamps.

Nests in large colonies, in swamps, in trees, sometimes very high. Nest a stick platform. Eggs 2-3, 2¾ by 1½ in., rough, elliptical, chalky white, more or less stained. Nesting period December-March in Florida. Sometimes a colony may occupy a territory 500 yd. wide and 5 miles long.

Food probably mostly fish, reptiles, crayfish, and other aquatic animals. Sometimes flocks may number as high as 5,000; since they often act in unison they may be noisy in flight when in large numbers. Colonies of them have some protection by groups of ornithologists. Usually silent but may give a guttural croak when frightened.

The American stork. Cannot be easily confused with others and probably does little or no harm to man's interests. It normally feeds in areas that yield little wealth to man, on species that are not particularly valuable. Protected by law, of course.

Family Threskiornithidae

White-faced Glossy Ibis, 187

Plegadis mexicana

Length to 26 in., bill to 6 in., wing to 10½ in. Face white, with naked white skin between eyes and bill. Head, neck, and under parts chestnut except in winter, when they are streaked with white and brown. Wings and tail iridescent purple. Legs, feet, iris, and bill tip red or reddish. In flight resembles long-legged crow.

Breeds from Oregon to Utah to southern Texas, southern Mexico, Florida, Peru, Brazil, and southward. Winters Mexico, north to southern California, Texas, and Louisiana and into South America. Found as far south as Straits of Magellan. Known from Pleistocene of California.

Nests built in marshes, at water level or up to 5 ft., of woven tule leaves, sometimes in old sites. Eggs 3-4, smooth, finely pitted, greenish-blue, 2 by 1¾ in. Incubation by both sexes, 3 weeks. Young helpless and naked when hatched, but soon covered with black down. Young molt in September, adults in March and July-August.

Food chiefly small, slow-swimming fish of shallower waters; also insects, crayfish, mollusks, and some plant materials collected at favored feeding grounds to which flocks fly from roosts by long diagonal lines, with steady rapid wing beats, with legs dangling behind. Call a hoarse nasal *ka-onk*, repeated.

Shot by hunters but can hardly be considered game since it is easy to hit and flesh has little flavor. In spite of this, has been sold in markets. Harmless, interesting bird, which should not be allowed to disappear from our skies.

Family Phoenicopteridae

Flamingo, 182

Phoenicopterus ruber

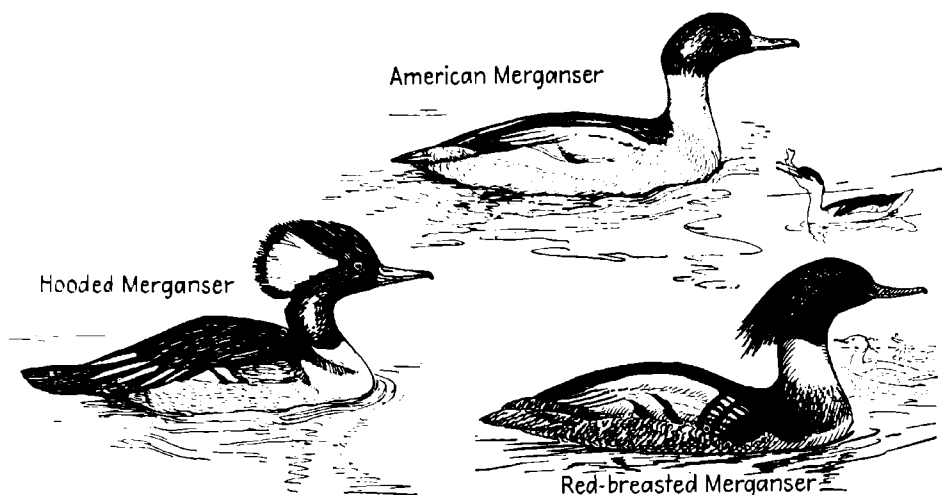
Length to 48 in., including unique 5-in. bill and abnormally long slender neck. Wingspread to over 5½ ft. Bill so shaped that upper bill serves as a lower bill when head is brought toward body near ground. Legs and neck about equal in length. Plumage a uniform vermilion to scarlet, with wings slightly darker.

Breeds in limited areas in Bahamas, Cuba, Haiti, Yucatan, Guiana, and Peru. Winters in much same region. Formerly made rather definite appearances in Florida but now usually seen there only as captives in park at race track near Miami. Has been reported north to coast of South Carolina.

Nests in great colonies, usually on mud flats. Nest a unique cone built of mud to a height of 13 in., on top of which bird sits in most grotesque manner. Nest seems more like a stool of convenience for adult than comfortable place for little bird to begin life. Egg, 1-2, white, 3½ by 2½ in.

Food chiefly the small mollusk *Cerithium*, which birds strain from mud with scoop-shovel-like movements of bill. Call, a repeated, slow *honk* not unlike some kinds of geese. Flight slow, steady, and labored as though birds lacked strength to carry dangling legs. 6 species of flamingos; 4, American; 1, United States.

Beautiful birds formerly prized for their plumage but now protected in United States, possibly too late for normal healthy survival. Common in many parks in tropical areas. A bird stretched out from tip of bill to tip of toes might well reach 5 ft. Should be protected at all times since they do little harm and are most attractive.



PHYLUM CHORDATA. CLASS AVES
 Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
 Subfamily Merginae

Hooded Merganser, 131
Lophodytes cucullatus

Length to 20 in., including 4-in. tail and 1 $\frac{3}{4}$ -in. bill. Wingspread to 26 $\frac{1}{2}$ in. Weight to 1 lb. 7 oz., female being slightly smaller. Drake, conspicuous because of black and white markings and white fan running back from eye on black head and neck. Female more drab, with black pointed bill, large head, and white wing bar.

Breeds in temperate North America from northern British Columbia to New York, south to Washington and central Florida. Winters from Massachusetts to British Columbia, and south to Cuba and central Mexico. Also found in Alaska, Wales, Ireland, and Bermuda on occasion. Haunts slow streams.

Nests in wooded areas near water. Nest in hollow tree or stump, often high above water but sometimes near ground. Eggs 5-12; 2 $\frac{1}{2}$ by 1 $\frac{3}{4}$ in.; nearly globular, white. Nesting dates March-August. Incubation 31 days, by female. 1 annual brood. An elaborate pursuit and display courtship.

Food fish, but much less than with other mergansers; also frogs, tadpoles, insects, grain, and other things. Mergansers swim beautifully, rise powerfully from water, and fly well. In flight, hood is depressed but white breast, slender pointed bill, and black and white markings are distinctive; with drakes, white head patch is still conspicuous in flight.

If any merganser is edible, it is the hooded merganser, but none can be considered a delicacy. It is doubtful if this species does serious damage to stream fishes unless the birds get the habit of feeding near fish hatcheries or happen to be present in large numbers.

American Merganser, 129
Mergus merganser

Length to 27 in., including 4 $\frac{3}{4}$ -in. tail and 2-in. bill. Wingspread to 39 in. Weight to over 4 lb. female being smaller than male. Male appears white with greenish-black head, black back, and orange feet and bill, latter being slender and pointed. Female gray with reddish crest and square white wing patch.

Breeds from Alaska Peninsula, across Canada to Newfoundland and south to central California, northern New Mexico, and New York. Winters mostly within United States, southern British Columbia, and Aleutian area. Will remain inland through winter wherever open water is available.

Nests near woodlands, near streams and lakes. Nest in hollow tree or stump or thicket, on or off ground, of grasses, twigs, and leaves with lining of gray down and straw. Eggs 6-17, 2 $\frac{3}{8}$ by 2 in.; elliptical, pale brown or creamy. Incubation 28 days, by female only, and 1 annual brood. Elaborate community courtship procedure.

Food probably largely fish, though nature and amount of these vary greatly in different parts of the country. Fish may be game fish, nongame fish, or fish that are enemies of game fish. Frogs, crustaceans, and mollusks are also eaten. Some vegetable matter has been found in diet but this is never considerable.

Possibly worst enemy of fish in whole duck family, but their status in this respect has not been definitely established. Birds themselves are almost impossible food for man, though in emergencies they may be edible if entrails are removed immediately after bird is killed.

Red-breasted Merganser, 130
Mergus serrator

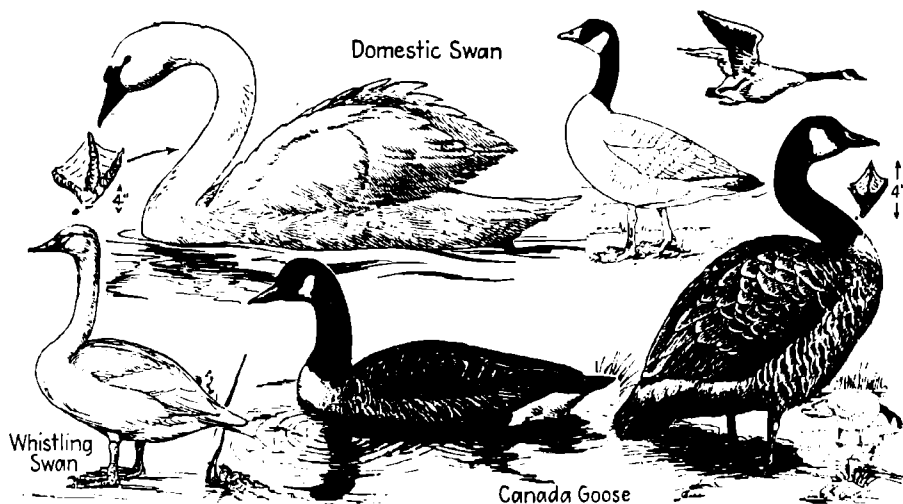
Length to 25 in., wingspread to 35 in. Weight to 2 $\frac{1}{2}$ lb. Red-breasted drake, with glossy greenish-black crested head, and brownish area on breast near water which is white in American merganser. Duck largely gray, with reddish crested head and large white wing patch. Temperature, 106-107°F.

American merganser more common in fresh water; red-breasted near sea. Red-breasted breeds from arctic Alaska to Newfoundland and south to New York, Minnesota, and northern British Columbia. Winters along Atlantic from Maine to Texas, and along Pacific from Alaska to Lower California. Also in India, China, Africa, and from Oregon Pleistocene.

Nests near waterway, marsh or island, hidden by grass or trees, with fine plant and feather lining. Eggs 6-12, creamy brown, 2 $\frac{1}{2}$ by 1 $\frac{3}{4}$ in. Incubated 28 days, by female. 1 brood yearly. Young molt from March through July and adults September-November. Females have complete molt August-October.

Food largely fish and other forms of small animals collected mainly by swimming at surface with bill open or diving if necessary; can swim under water and pull food from bottom. Often seeks food in a flock, advancing like an army in a long line. Food commonly swallowed whole, even to size of an 8-in. eel.

Probably of little value and may be of some destructive nature particularly with American merganser, which feeds in small streams where young fishes of game and other species may abound. Flesh is not edible because of the rank fish flavor. Known as "sheldrake," "fish duck," and "sawbill."



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Cyginae

Domestic Swan
Cygnus mansuetus

C. mansuetus is the mute swan, of which there is a black and a white variety. Whooping swan, *C. cygnus*, has yellow basal portion of bill and area in front of eyes. Whistling swan, *C. columbianus*, is 55 in. long and has yellow in front of eye. Trumpeter swan, *C. buccinator*, has no yellow before eye and is 65 in. long.

Mute swan and whooping swan are European though mute is widely distributed as a domestic bird. Whistling swan and trumpeter swan are American, latter being one of rarest American birds. Whistling swans breed through barren northern Canada and northeastern Siberia and winter south to Mexico.

Swans probably mate for life. Female increases size of nest while eggs are being incubated until it may be 2 ft. high and 6 ft. wide. Eggs 2-6; (mute) greenish-gray, (whistling) pale yellow; weight (mute) 5-8 oz.; measure (whistling) $4\frac{1}{4}$ by $2\frac{3}{4}$ in. Incubation by both parents 35-40 days. Life span to 102 years.

Swans do best in large ponds where parents care for young *cygnets*, often carrying them on their backs. Require green food even in winter. Are fed mixture of wheat, barley, cracked corn, buckwheat, stale bread, and soaked dog biscuit, particularly when young are being raised. Males fight intruders vigorously with wings.

Essentially ornamental domestic birds and in past were owned only by privileged classes. Do not make gentle pets nor get along well with other domestic birds. Mourn loss of mates a long time. Reduction in population of wild species is evidence of poor game management in past. Fly in V formation.

Whistling Swan, 180
Cygnus columbianus

Length 4-4½ ft., including 4-in. bill and 8½-in. tail. Wingspread to about 7 ft. Weight to 20 lb. Female slightly smaller than male. Yellow spot in front of eye and smaller size separates whistling swan from trumpeter. Trumpeter and whistling swans carry neck erect when on water, while mute swan arches it gracefully, bill down.

Breeds north of Arctic Circle from northern Alaska to Baffin Bay, and south to barren Canada, northeast Siberia, Alaska Peninsula, and St. Lawrence Islands. Winters from Chesapeake Bay region, along Atlantic Coast from Massachusetts to Florida and south to Gulf of Mexico and northern Lower California. Migrates through Minnesota to New York area, about mid-October.

Nest a heap of vegetable rubbish, concealed among plants near water's edge. Male *cob* courts female *pen* elaborately. Eggs 2-8, $4\frac{1}{2}$ by 3 in., rough-shelled, pale yellow or cream white. Incubation probably 40 days, by both sexes. Young *cygnets* downy, hatch late June, and family remains together for a year, young getting adult plumage in about 15 months.

Food largely plants of waterways, particularly wild celery. Considered wasteful of valuable duck foods by many persons. May also eat mollusks and crustaceans. In taking wing, will run along surface of water for 15-20 ft. Flies in a waving V formation possibly to 100 m.p.h. Remains in close flocks; many killed going over Niagara Falls.

Protected by law at all times in Canada and United States, including Alaska. Famed "swan song" supposedly given just before death is an interesting myth with little basis in fact. Normal call a clamoring, quavering, varying musical *wow-wow*, repeated.

Canada Goose, Honker, 172
Branta canadensis

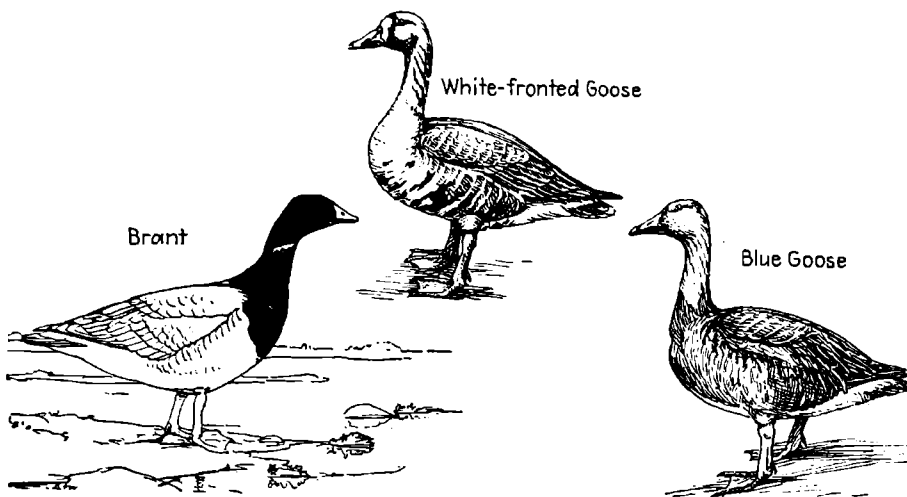
Length to 3½ ft., wingspread to 5½ ft. Weight to 18 lb., with female, *goose*, smaller than male, *gander*, and young, *goslings*, often weighing under 8 lb. and duller in color. Bill and feet black; back and wings gray-brown. Goslings olive-yellow. Call a high- or low-pitched *honk*. Flight in V-shaped flocks.

Breeds from Labrador to Mackenzie, south to Gulf of St. Lawrence, South Dakota, Utah, and northern California, formerly to Tennessee. Winters from southern British Columbia to southern New England and Nova Scotia and south to southern California, Mexico, Bermuda, and Jamaica. Known from Pleistocene of Florida, Oregon, and California.

Adults mate for life, breeding when 3 years old. Gander defends goose on nest, which is usually on ground but sometimes in trees. Goose incubates the 5-9, $2\frac{1}{4}$ by $3\frac{1}{2}$ -in. buffy eggs, 28-30 days, yellow goslings hatching in June. 1 annual brood. Adults have 1 complete annual summer or fall molt, losing flight feathers all at once.

Powerful. Feeds largely on roots, grain, and other vegetable matter or on insects such as grasshoppers. Eelgrass a favorite aquatic food. Intelligent in escaping hunters; when wounded, lies flat effectively on or in weeds. Apparently young accept leadership of older birds. Flight deceptive, rated from 75-120 ft. per sec.

Among commoner and most valuable of wild waterfowl. Formerly more abundant. In early days, supplied much food for settlers and filled many feather beds. Ranks high in supporting industries dependent on hunting. Decrease in numbers is traceable primarily to unwise wildlife management and short-sighted laws.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anserinae

American Brant, 173a
Branta bernicla

Length to 30½ in., wingspread to 52 in. Weight to 4 lb., with female smaller than male. Head, neck, and breast black with a little white showing above water forward. White patch on neck instead of on face and light below. Gosling gray, with chin, throat, and neck lighter. Flight formation irregular. Call a guttural *bonk*.

Breeds from Arctic and eastern North America through Greenland to Spitsbergen Archipelago, with related black brant and barnacle goose on through Siberia. Winters along Atlantic Coast from Massachusetts to Florida and more rarely along Pacific Coast from British Columbia to California. Related Old World races. Fossil from Oregon Pleistocene.

Nests along coasts on marshy areas, nests being down-lined depressions on ground from mid-June to mid-July. Eggs 4-8, 2½ by 1½ in.; appearing to be long and whitish. Incubation by female. Young browner than adults when southern migration begins in late August or early September. 1 annual brood.

Feeds primarily on plant materials and, in captivity, will thrive on grains. May feed on shellfish if necessary. Rarely dives for food. Can run about nimbly on land almost as fast as sandpiper. Is unusually wary of hunters during migration period. Flies low over water and high over land, with speed up to 70 ft. per sec.

One of most delicious of waterfowl when it has been feeding on plants. Formerly was most sought waterfowl in New England but is now receiving considerable protection. In 1 year (1927) New York take was 4, but 200 is more normal. It seems to respond to protection and so fact of continued low numbers is due to poor management practices.

White-fronted Goose, 171
Anser albifrons

Length to 2½ ft., including 6½-in. tail and 2½-in. bill. Wingspread to over 5 ft. Weight to 6 lb., female being slightly smaller. Sexes colored alike. Head and neck brownish-gray, with a white band in front of face and on chin, white front being bordered by black. General appearance gray-brown, with mixed black and white on breast.

Breeds in Arctic America from Yukon to Anderson River in Mackenzie and on west coast of Greenland, Iceland, Lapland, and Arctic Siberia to Bering Strait. Winters in western United States from British Columbia to Texas and Illinois, with a few east even to Atlantic. Common goose west of Mississippi.

Noisy courtship in May. Nest a grassy border of a waterway, usually lined with grasses or moss but often a mere hollow. Eggs 4-8, 3½ by 2 in.; dull yellow-white or greenish-yellow, commonly discolored. Incubation 28 days, by both parents. Goslings mostly with brownish-buff down, being lighter beneath. Young reach weight of nearly 4 lb. by October.

Food, nuts, acorns, grain, berries, and grass; almost wholly vegetarian. Northern migration begins in March and main fall flight is in September-October. Birds fly high in V's like Canada geese but show black and white breast, white tail coverts, and yellow legs if near enough. Call, a repeated *wah-wah-wah* given in flight, laughter-like.

White-fronted goose in fall among most delicious of wildfowl and therefore a popular game bird. In nesting area, many are killed by natives during time when flight feathers have molted. Birds are often approached by using a bullock as a moving blind, but are suspicious of horses if they are used as blinds.

Blue Goose, 169.1
Chen caerulescens

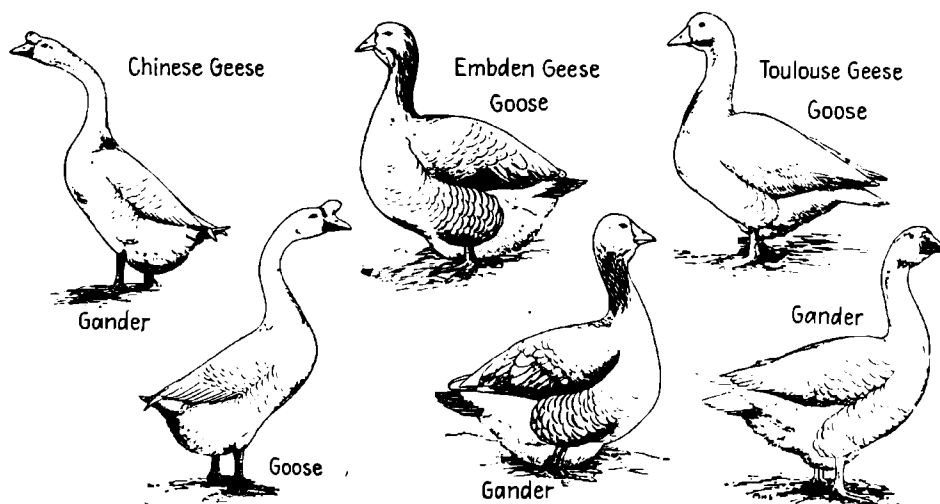
Length to 2½ ft., including 6-in. tail and 2½-in. bill. Wingspread to 4½ ft. Weight over 4 lb. Conspicuous because of white head and neck and dark gray-brown on back. Related emperor goose has black foreneck. Bill pinkish. Some variation in degree to which breast is darkened.

Breeds in southwestern Baffin Bay and Southampton Island. Often shares nesting sites with lesser snow goose, with which it sometimes interbreeds. Winters from Louisiana to central California and north to British Columbia, but appears in migration through Montana and Alberta to the Athabaska-Mackenzie territory, occasionally east of Mississippi.

Nest on top of slight rise, on land near water, formed of moss and vegetation, with lining of fine down and grasses, being generally large and bulky. Eggs 3-5, 2 by 3 in.; white or pale cream with a slight luster. Incubation 25 days; some doubt that male takes part although he strands guard. Young can run well within a day.

Young and adults eat and drink well, young increasing their weight about 20 times in first 2 months. In spring migration, about 11 weeks are required for 3,000-mile migration from winter quarters to nesting area, spring route being some 600 miles longer than southern route made in fall. Fall migration at height in September.

An important game bird of Louisiana and Texas coast area. Big flocks may be destructive of vegetation in normal feeding areas of ducks and sometimes over cultivated lands, this apparently because geese feed more on roots and underground parts of plants than on tops.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anserinae

Chinese Goose (Domestic)

Adult gander 12 lb., young gander 10 lb. Adult goose 10 lb., young goose 8 lb. 2 breeds: white, entirely white; and brown, a dark, grayish-brown; sexes and young colored alike. Head with orange knob at base of bill. Bill of medium length, stout, orange. Eyes large and blue. Toes yellow.

Native of China but introduced rather widely through world, more as an ornamental variety than for any other purpose. Stands remarkably erect and walks with pronounced arch to long neck. Egyptian goose, also more or less of ornamental type, weighs to 10 lb., is gray-black to brown, ferocious and wild.

This variety is essentially a show or ornamental goose and is not raised in sufficient numbers to be considered an important domestic bird.

Eggs of Chinese and Embden geese are both white, former weighing $3\frac{1}{2}$ –4 oz., latter 4–5 oz. Nest usually in a box or barrel, on ground or floor; feather-lined. Incubation for 28 days. Goslings downy, creamy white. For first 36 hours after hatching, feeding is not necessary. After that, they should be fed 3–4 times daily for 2–3 weeks a mixture of stale bread soaked in water or milk and finely chopped boiled eggs. At 3 weeks, they may be turned out to pasture, then requiring only 1 feeding a day of a light mash of grains. Both sexes may provide some protection for young, but goose is more effective.

Food: except in winter, most domestic geese can glean a living from well-watered, temperate-zone, farmlands where grass is main food. In winter, they are fed grain and some roughage such as silage. Oats are preferred grain for mature birds, though corn, wheat, barley or mixtures are acceptable. There should always be abundant roughage and grit. Fresh drinking water should always be present. Laying birds should be fed a mash made of 3 parts of bran or shorts, 1 part of cornmeal, and 1 part of meat scraps. Ordinarily, a flock of geese can protect itself from average enemy. An angered gander can put a child or dog to flight if necessary.

Embden Goose

Adult gander 20 lb., young gander 18 lb. Adult goose 18 lb., young goose 16 lb. Entire plumage of young and old pure white, eyes blue, shanks deep orange and long; toes deep orange and straight. Head relatively large. Bill of medium length and stout at base. Wings large, well-rounded, and strong.

Developed as a domestic bird in Germany but has been widely adopted by poultrymen in other parts of the world. It thrives where water and good grass grazing are to be had and easily lends itself to being raised in flocks.

Geese are more often reared as domestic birds in Europe than in America. Here they are considered a bit too rich for ordinary meals and so are reserved for special occasions, as are turkeys, which possibly because of their milder flavor have won more favor. In Europe children are frequently employed as gooseherds.

Toulouse Goose

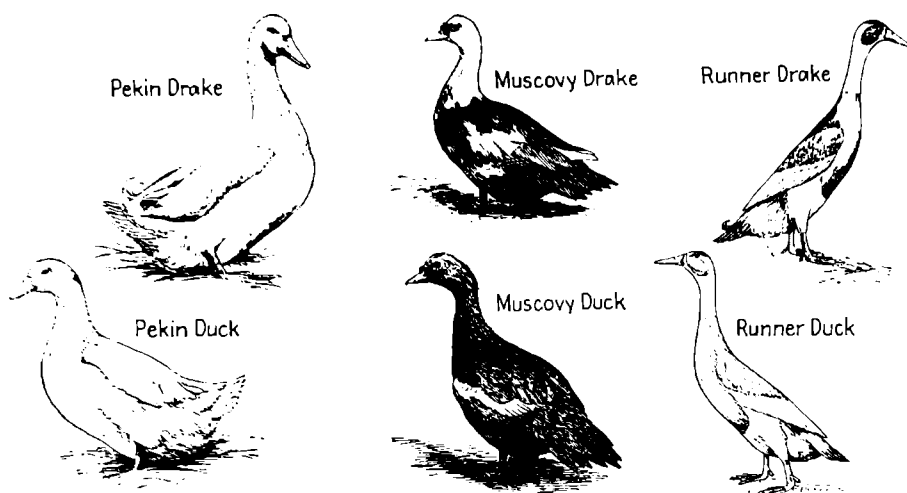
Adult gander 26 lb., young gander 20 lb. Adult goose 20 lb., young goose 16 lb. Sexes and young colored alike: gray above, under parts light gray to white, wings gray with lighter tips, tail gray and white, shanks stout and deep reddish-orange, toes straight and reddish-orange, eyes brown or hazel, large, not prominent.

Native of southern France, where breed is raised in large flocks; larger and heavier than Embden goose raised in neighboring Germany. The Toulouse or domestic gray goose is raised widely throughout world by poultrymen wherever there is a market for goose flesh.

Eggs of Toulouse goose are white and weigh 4–5 oz.; laid in nest lined with goose feathers. Goslings downy, gray above and creamy below, unlike breeds previously considered. Young must be kept dry, even free from dew.

If one wishes to start raising geese by purchasing eggs and hatching them with a hen, not more than 6 eggs should be given each hen. Generally better to start in a small way than to try too many at first.

This is the breed of goose which is the great flesh producer and which is raised in great flocks in various parts of the world. Birds are not normally so wild as other breeds and their great size makes them more valuable. Temperature of geese, 106°F.



PHYLUM CHORDATA. CLASS AVES
 Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
 Subfamily Anserinae

Peking Duck

Adult drake 9 lb., young drake 8 lb. Adult duck 8 lb., young duck 7 lb. White or creamy where feathered. Shanks and toes reddish-orange. Bill orange-yellow. Eyes lead-blue. Tail rather erect; drake with several stiff curled feathers. Wings short. Head long. Neck of medium length, carried arched forward.

Native of Asia, derived from wild mallard. Commonly raised where fast-growing young ducks are desired for a special market, therefore a common breed near large cities.

Peking ducks are superior for flesh, young, roasting ducks known as "green" ducks bringing a high price if properly forced to grow rapidly. Feathers of ducks raised for flesh are saved and provide a supplementary income. Peking duck eggs have a superior food quality and are unusually large.

Muscovy Duck

Mature drake to 10 lb., young drake 8 lb. Mature duck to 7 lb., young duck 6 lb. 2 varieties, a white form and a colored form where sexes are colored alike with black body, breast, and tail, and black wings with large white patches. Shanks and feet yellow to dark lead color. No curled tail feathers. Eyes blue.

Native of tropical America from Mexico to southern Brazil but domesticated and rather widely distributed. Never apparently so common as other breeds even though this is largest of domestic ducks.

Muscovy ducks are raised chiefly for meat. Though they may look fierce they may often make excellent pets. Quality of meat is good but growth is not commonly so rapid as with Peking ducks. Ducklings of Muscovy ducks are downy and brown instead of yellow.

Runner Duck

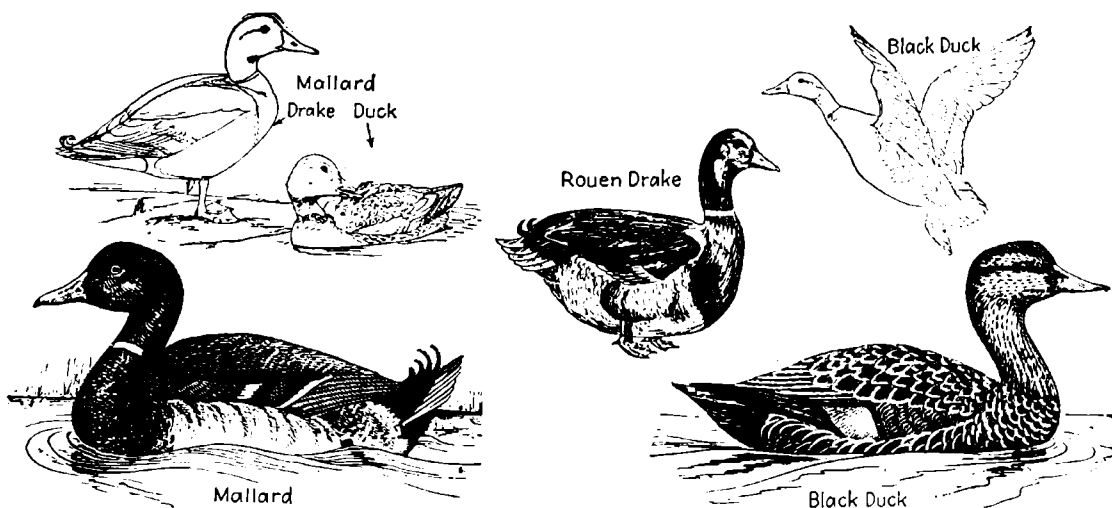
Adult drake 4½ lb., young drake 4 lb. Adult duck 4 lb., young duck 3½ lb. Ducks and drakes colored alike. Fawn and white, white, and penciled varieties. Bill long, wedge-shaped, yellowish-green with a black tip. Carriage erect. Body long and slender. Drake has several curled stiff tail feathers.

Originated in India but takes place in duck world similar to that occupied by Mediterranean breeds of chickens.

Runner ducks are raised primarily for their egg production. They are too small for meat production but they lay profusely, relatively large eggs. Male gives a low *queak, queak* call and female a loud harsh *quack, quack*.

Peking ducks make rather poor mothers compared with many other breeds. Ordinarily domestic ducks such as Peking, Muscovy, and runner breeds lay white eggs, averaging 3-3½ oz. in weight. Incubation for Peking and runner ducks, 28 days; for Muscovy ducks, 35-37 days. Ducks should be housed where they are protected from rats and skunks. Floor should be dry, clean, and commonly covered with shavings, sawdust, or chaff since ducks' droppings are filthy. There should be ample shade, and if convenient, adequate water for swimming. Many duck raisers keep young ducks from water until they are several weeks old, particularly when they are brooded by a hen. After first month, young ducks are able to feed themselves well if provided with a suitable range. Well-fed young Peking ducks may reach a weight of 8 lb. in as many weeks, particularly if they are kept from water except for what they get in their feed. Temperature 106-108°F.

Ordinarily, where ducks are not being forced, adult ducks in relatively close confinement are fed twice daily a ration of mixed grains soaked in water, with some green feed or corn in morning, and a mash in evening. Mash for ducks is made of bran middlings, cornmeal, and greenstuffs. Food is placed in a low trough with an abundance of water near by. Meat scraps are sometimes added to the mash, and vegetable scraps and small vegetables, like potatoes boiled with skins on, may be added. Grit should always be available. First week, ducklings are fed 5 times daily a mash of 2 parts bran, 1 part cornmeal, 1 part middlings, and some greens. Later, cornmeal ration is increased and meat scrap added. At 4 weeks, feeding should be cut to 4 times a day. After that, young ducks should be allowed to range with duck after insects and may be fed as adults. When growth is forced, mash feedings soaked almost to a slop with extra water are commonly used.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anatinae

Mallard Duck, 132

Anas platyrhynchos

Length to 28 in., including $4\frac{1}{2}$ -in. tail and $2\frac{1}{2}$ -in. bill. Wingspread to 40 in. Weight to $3\frac{3}{4}$ lb., duck being somewhat smaller than drake. Drake, head and neck green, breast purple-brown, collar white, other parts brownish-black, ash-gray, and blue, tail curled. Duck with no collar, and with head and neck brown, wing bar purple.

Breeds from Pribilof Islands around Arctic Circle, south through United States to Virginia, more commonly in the west, south through Europe to northern Africa and through Asia into Japan. Winters south to Panama, South Africa, India, and Borneo, and north where there is still open water. Probably commonest of wild ducks.

Mating promiscuous, many drakes often mating with 1 female. Drake hisses, calls, and pursues duck. Nest hidden by duck in vegetation relatively near water. Eggs greenish to gray-brown, 6-13, $2\frac{1}{2}$ by $1\frac{3}{5}$ in., laid on ground. Incubation 26-28 days, by duck, and ducklings are reared by duck. Ducklings downy yellow, soon able to walk and swim.

Excellent destroyer of mosquito larvae, being better than goldfish for this purpose. Also eats grain and vegetation, including arrowweed, chufa, pickerweed and bulrushes. Can fly 60 m.p.h. or short distances 95 ft. per sec. Temperature 107°F . Appears slow and steady in flight, wings being brought only a little below normal level of the body.

Probably most valuable of all wild ducks because of abundance, ease in harvesting, and general hardiness. Flesh is excellent, particularly when bird has fed on better plant foods. Birds reared in captivity for freeing for hunting do not readily lose tameness, so shooting them is about like shooting barnyard fowl.

Rouen Duck, Domestic Mallard, 132

Anas platyrhynchos

Size about same as that of Peking and Aylesbury breeds, drake weighing up to 9 lb., duck to 8 lb. Coloration much like that of wild mallard, drake having green head and neck, gray-brown body feathers and typical curled tail. Female like mallard duck but with dark bill. Purple, white-edged wing bar in each sex.

Rouen ducks are found practically everywhere in world where there are sufficient water and food. Beside those ducks already considered as domestic ducks, there are the all-black, lighter weight Cayuga duck; the gray and white call duck; and the large Aylesbury duck which is white like the Peking. Many breeds interbreed freely with tame or wild ducks.

As with other domestic birds, breeding is highly promiscuous. Male is not mindful of interests of any but himself. Eggs to 14 or more in a clutch, 2 by $2\frac{1}{2}$ in.; yellowish-white to buff or greenish, and frequently dirty. Incubation 26-28 days, by duck only. Ducklings follow mother until well developed.

Rouen ducks are fed twice daily a mash of bran middlings, cornmeal, and greenstuff, with occasional meat scrap and oystershell. They are also allowed to forage for themselves or are fed grain for fattening. Ducklings fed 5 times daily during first week and less frequently thereafter. Range ducks feed much as do mallards.

Raised primarily for use as flesh for food for man, though many mallards are raised on game farms and freed for shooting. However, sport in harvesting these animals must be decidedly tame, comparable to shooting canaries in their cages.

Black Duck, 133

Anas rubripes

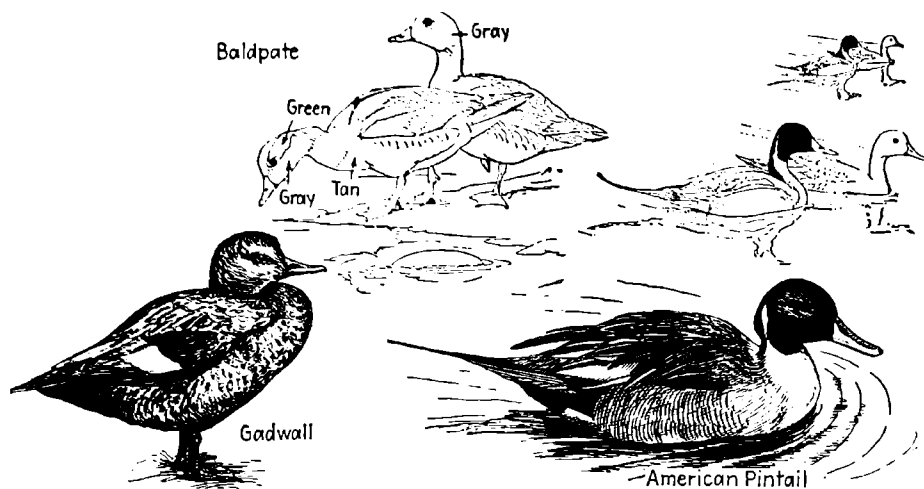
Length to $23\frac{1}{2}$ in., wing to 11 in., wing-spread to 3 ft., bill $2\frac{3}{5}$ in. Weight to 3 lb. 10 oz., with duck under 3 lb. Resembles female mallard but is darker, lacking white borders on blue on wings and showing conspicuous white beneath wings in flight. Drake's bill yellowish, duck's olive. Drake's legs more orange than duck's.

Breeds from Manitoba to Labrador and south to North Carolina and Colorado. Winters along Atlantic Coast of United States and south to Florida. Sometimes raised on game farms for freeing as game bird.

Drake courts by short flights and head bobbing. Nest commonly on ground, sometimes on stumps, down-lined. Eggs 6-12, greenish-gray; $1\frac{3}{4}$ by $2\frac{2}{5}$ in. Incubation by duck, 26-28 days, 1 annual brood. Young fluffy, yellow, darker above than in mallard. Immature young more striped below than adults. Voice a loud quack; drake, mellow.

Food 3 parts plant, 1 part animal matter. Half of food is pondweeds, eelgrass, wild celery, but grain welcome where available. May eat crayfish and fishes but these injure value of duck as food for man. May eat shrimps and mussels. Feeds commonly at night. Has remarkable hearing. Flight speed, 55-90 ft. per sec., 45 m.p.h.

Among wildest of ducks, even when raised in captivity, therefore considered good game bird. Probably most valuable of food and game wildfowl of eastern United States. Migration towards seaboard begins in September but birds visit fresh water regularly to feed and so may be accessible to hunters there. Temperature, 106°F .



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anatinae

Baldpate, Widgeon, 136
Mareca americana

Length to 22 in. Wingspread to 35 in. Weight, male 2 lb. 7 oz., female to 2 lb. Male with conspicuous white crown; rest of head gray, with green from eye back; bill blue with black tip; white patches under tail and on forewing; rest of body, mostly pinkish-brown. Duck ruddy brown, neck and head gray, white on forewing.

Breeds from northwest Alaska to north-eastern California and east to northern Indiana and Hudson Bay. Breeds mostly in western part of range. Winters from Massachusetts to Vancouver Island and southern Alaska to Panama. Sometimes found in Japan, France, and Hawaii. This species known as fossil from Pleistocene of Oregon and California.

Courting male swims over water with extended neck, raised wings, giving whistling notes. Mates usually before coming to nesting ground. Nest usually on dry ground, hidden or open, of grasses with abundant down lining. Eggs 6-12, $2\frac{1}{2}$ by $1\frac{1}{2}$ in.; white to cream or buff, incubated by female. Nesting period from late May to mid-July. 1 annual brood.

Dives poorly but lives mostly on water plants such as wild celery, often stolen from other ducks that are better divers. Food pondweeds 43%, grasses 14%, algae 8%, sedges 7%, animal food 7%. Insects constitute small proportion of food except in summer. Flock of flying baldpates, conspicuous because of large white patches along fore part of wings. This is duller in immature birds.

Superior game bird without record of being destructive to agricultural crops. Food value high. During breeding season and when birds are young, helps definitely in controlling any increase in destructive crickets, grasshoppers, beetles, and similar insects. Interesting because of taking food from other ducks; not so dependent as rumors contend. Male whistles *wee, wee, wee*.

Gadwall, 135
Anas strepera

Length to 22 in., including $4\frac{1}{2}$ -in. tail and $1\frac{3}{4}$ -in. bill. Wingspread to 35 in. Weight, drake to $2\frac{1}{4}$ lb., duck smaller. Slender, gray, with white patch on hind edge of wings, with black tail coverts that are conspicuous next to pale gray wings. Duck browner than drake, with white also on wings. Belly white. Bill partly yellow.

Breeds from Little Slave Lake and Hudson Bay to central British Columbia, south to Washington, Oregon, California, Utah, Colorado, and New Mexico, and east to Minnesota and Ohio; also in Europe and Asia. Winters from Chesapeake Bay to north-eastern Colorado, and southern British Columbia to southern Lower California, central Mexico, and southern Florida.

Nests on dry land among weeds, usually near water, on ground commonly on islands in lakes. Nest a hollow, lined with plant stems and down. Eggs 7-12, $2\frac{1}{2}$ by $1\frac{1}{2}$ in.; oval, creamy white. Nesting period May-July. Incubation 28 days. 1 annual brood. Downy young like young mallards but paler and less yellow. Young much like duck.

Food, insects, snails, small fish, tadpoles, crayfish, mollusks, roots, nuts, tender vegetation, and grain. Nature of food determines considerably value of flesh of bird for food. More vegetarian than other American ducks. Flies in small compact flocks, rising rapidly; rests high on water.

Valuable game bird but less common than might be desired particularly in the East, where it probably never was very abundant. Drake croaks in flight much as does a raven or gives oft-repeated, high-pitched *quack* weaker than that of the mallard.

American Pintail, 193
Anas acuta

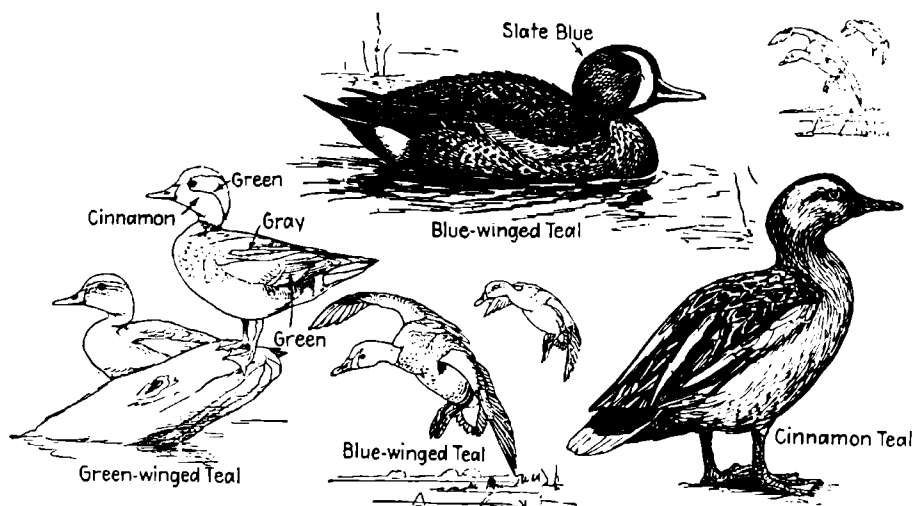
Length drake to 30 in., duck to 22 in., wingspread to 3 ft., tail of drake $7\frac{1}{2}$ in., of duck $3\frac{3}{4}$ in. Weight to $2\frac{3}{4}$ lb. Conspicuous in field because of long slender neck and tail. Drake shows white neck, and white across belly. Duck with conspicuous wedge-shaped tail.

Breeds from Arctic Alaska to New Brunswick, south to California and New Jersey; rarely east of Lake Michigan. Winters from Alaska to Massachusetts, south to Panama but uncommon in East. Closely related Old World form found in Europe, Asia, North Africa. Known in Greenland, Labrador, China, and from Pleistocene of Oregon.

Drake mates early with duck. Nest in grass or sheltered dry spot. Eggs 5-12, greenish-buff; $1\frac{1}{2}$ by 2 in. Incubation by duck, 22-23 days. 1 annual brood. Duckling grayer or browner than common associates; later colored like duck though grayer; takes on breeding plumage at 22 months. Adult molts September-November.

Food largely vegetable matter, including grain, but also aquatic insects, grasshoppers, and the like. Can dive and swim readily under water, particularly when wounded, but is normally a surface feeder. Extraordinarily alert, taking to wing and rising steeply when disturbed, and attaining speed of 60-100 ft. per sec., 45 m.p.h.

Among most beautiful of ducks and earliest to visit East in spring migration. Desirable as game bird because of alertness, speed in flight, and exceptional food value when proper food has been available. Could probably be more abundant by wise wildlife management. Courting drake gives sweet low soft whistled call notes.



PHYLUM CHORDATA. CLASS AVES.
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anatinae

Green-winged Teal, 139

Anas carolinensis

Length to 15½ in. Wingspread to 24 in. Weight to 14 oz., with female slightly smaller. Male, general appearance gray with brown head, conspicuous white mark in front of wing, green patches on side of head and on wing. Female, speckled gray, with green spot on wing. Young much like short-tailed female.

Breeds from northern Alaska to southern Ungava, south through central California, northern New Mexico, southern Minnesota, western New York, and Quebec. Winters from southern British Columbia to Montana, Nebraska, Kentucky, Chesapeake Bay area and south to Bahamas, West Indies, Honduras, and southern Mexico. Fossil from Florida, Oregon, and California Pleistocene.

Nest on dry ground, near or far from water, in open or at edge of brush timber, a hollow of grasses and feathers, with much down in lining. Eggs 7-12, 1¼ by 1½ in.; blunt pale greenish-brown to pale dull brown. Nests in May. Incubation 21-23 days, by female. 1 annual brood. Ducklings gray-brown, with eye line, crown, and back of neck brown.

One of swiftest flying ducks, by some estimated to fly 60 m.p.h. Flies in compact flocks that make quick close turns. Floats high on water. Food animal matter, including insects, mollusks and fish to about 10%. Remainder water plants, their seeds or sometimes grain, nuts, grapes, berries, and similar fruits. May feed in marine areas.

Flesh excellent when bird has been feeding on plants but rank and useless when it has been feeding on some kinds of animal matter. Because of great speed, it is considered a challenge to expert marksmen. In East a late fall migrant; in West, an early fall migrant. Generally tame. Often found with barnyard fowl if undisturbed.

Blue-winged Teal, 140

Anas discors

Length to 16 in., wing 7½ in., bill 1½ in. Weight to 1 lb. Drake small, dull-colored, with white crescent before eye and light spot at base of tail; in flight, shows blue patch on fore part of wings. Duck with patch on fore part of wing, otherwise mottled.

Breeds from central British Columbia to New Brunswick and south to northern Nevada and New York; rarely in Florida, Texas, and Louisiana. Winters from South Carolina to southern California and south to central Chile and Brazil. Also accidental in Greenland, British Isles, and Denmark. Known from Pleistocene of Oregon.

Nest on ground in dry meadow or marsh, basket-like, and concealed with overhanging grass. Eggs 6-15, olive to brownish-white; 1½ by 1½ in. Incubation by duck, for 21-23 days. 1 annual brood. Ducklings yellow-brown; darkest on rump, crown, and eye line.

Food 70% vegetable matter, mostly water weeds; 10% insects including grasshoppers, ants, moths, flies and beetles; and remainder, other animals including snails and shrimps. One of fastest flying ducks, traveling over 100 ft. per sec. and keeping in close flocks, to their own misfortune.

Excellent game bird, though too small to provide much flesh as food. Numbers have decreased unreasonably, but with protection shows power to recover numbers rapidly since it is most prolific. Makes southern migration early compared with that of some larger species, and spacing closed seasons could restore its numbers.

Cinnamon Teal, 141

Anas cyanoptera

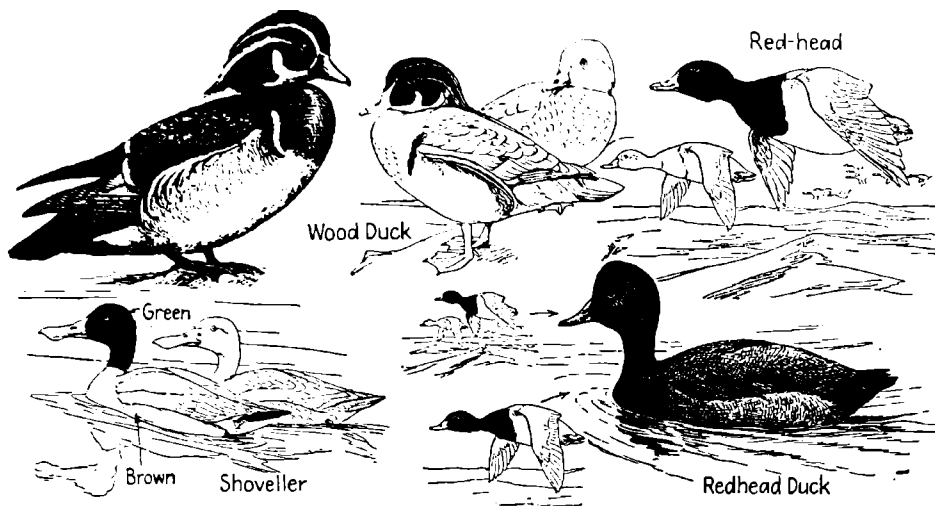
Length to 17 in. Wingspread to just over 2 ft. Weight to about 1 lb. Drake dark cinnamon-red, with large chalky-blue areas along front of wing and easily identified. Duck almost identical with female blue-winged teal, having same blue wing patch. Probably impossible to distinguish between them in field.

Breeds from southern British Columbia and western Saskatchewan through Oregon, Washington, and central California to western Texas and Lower California. Another group breeds in South America from Buenos Aires and the Peruvian Andes to Straits of Magellan. Winters from central California to Arizona and Brazil.

Nest on ground, usually basket-like but always heavily lined with ducks' feathers, often to 100 ft. from water. Eggs 6-14, 1½ by 1½ in.; white to pinkish-buff. Incubation entirely by duck, though drake may remain near nest until eggs hatch.

Food ¾ vegetable matter. Stomachs of 41 showed 34% sedges, 24% pondweeds, 8% grasses, 3% smartweeds, 10% insects, 9% mollusks. Interesting duck because of 2 groups in Northern and in Southern Hemispheres, between which there is no migration.

A popular game bird in West, formerly slaughtered in great numbers by market hunters. It is difficult for one who has watched a group of these birds to understand how anyone could take pleasure in shooting such animals.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Anatinae

Subfamily Aythyinae

Shoveller, 142
Spatula clypeata

Length to 21 in. Wingspread to 35 in. Weight to 2 lb., with female smaller. Male, head black with green cast, breast white, belly and sides reddish, patch on front edge of wing light blue. Female, brown, mottled, with large pale blue wing patch. Male gives impression of being black and white at a distance. Sits low in water, with bill downward or, in flight, extended forward.

Breeds from Bering Sea coast of Alaska to Great Slave Lake, Iowa, Nebraska, New Mexico, and southern California; formerly to western New York. Winters from southern British Columbia to California, Central America, Colombia, through lower Mississippi Valley and along Atlantic Coast from New England to West Indies. Modern form as fossil from Oregon and California Pleistocene.

Nests May-June in open grassy or brushy grasslands or edge of marshes. Nest a grass-lined hollow, down-rimmed, near or far from water. Eggs 6-14, 2½ by 1½ in.; smaller and whiter than mallard eggs. Incubation 21-23 days, by female. 1 annual brood. Young drakes variable; may reach adult plumage in 17 months. 2 annual molts in adults.

Food 66% animal food, 34% plant food. Probably largest single part of diet is pond snails, with aquatic insects next. *Ruppia maritima* (see p. 100) is favored plant food. It may eat land insects when these are abundant and convenient, but its bill fits it particularly for straining from water and oozes smaller animals of fresh-water ponds and streams.

Known to do no damage to agricultural crops and when it has been feeding on plants is an excellent wild duck for table. This coupled with its occasional destruction of harmful insects makes it a species decidedly worthy of protection and encouragement.

Wood Duck, 144
Aix sponsa

Length to 20½ in., wing to 9½ in., wingspread to 29 in., tail 4½ in. Weight to 1½ lb. Duck smaller than drake. Drake most highly colored North American duck in winter and spring; highly iridescent. Duck and, in summer, drake show crested heads with white areas around eye; dark-brown, with light flanks and white belly.

Breeds in most of United States and in southern provinces of Canada, rarely farther north. Winters from southern British Columbia to southern Virginia, Michigan, or Massachusetts, south to central Mexico, Jamaica, and sometimes Bermuda. Lives commonly along wooded streams and lakes inland. Known from Pleistocene of Oregon.

Nest usually in a hollow tree or on limb, 3-50 ft. above ground or water or rarely on ground, in nesting box lined with gray down. Eggs 8-15; pale brown to brownish-white, 2 by 1½ in. Incubated 28-30 days, by duck. Young remain in nest a day or a little longer after hatching.

Food 90% vegetable matter, such as 10% duckweed, 9% cones and galls, 9% sedge seeds and tubers, 8% grasses and seeds, 6% pondweeds, and 6% nuts. The 10% animal matter is mostly insects, young birds feeding voraciously on mosquito wrigglers.

A beautiful wild bird protected by law but probably shot by hunters who do not recognize it or who do not care. Has been suggested as national bird because of peaceful habits, because it nests in every state in Union, and because of beauty. Removing old timber has reduced numbers. Temperature 107°F.

Redhead Duck, 146
Aythya americana

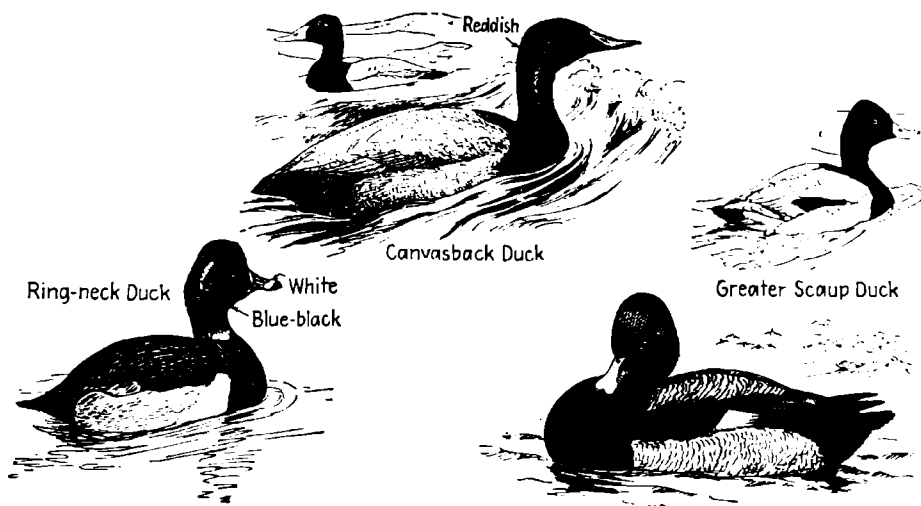
Length to 23 in., wingspread 33 in., bill 2¼ in. Weight to 3 lb. Drake with high forehead and reddish-brown head, mostly gray but breast, neck, and tail black, bill blue; in flight, shows gray wing band. Duck brownish, with broad gray wing stripe; smaller than drake.

Breeds from northern British Columbia to Wisconsin and south to southern California and Nebraska. Winters from southern British Columbia to southern New England and south through central Mexico and West Indies. Occasionally in Alaska. Known from Pleistocene of California. Reared sometimes on game farms and kept in parks.

Nests over water in marsh border, among vegetation, usually a deep well-made nest. Eggs 6-22; olive to brownish-cream, 2½ by 1¾ in.; sometimes laid in nest of other kind of duck. Incubation by female, 22-24 days. 1 yearly brood. Female often with unusual white feathers. Ducklings pale yellow, downy, with spot back of base of wing.

Food principally plants of fresh waters such as wild celery, pondweeds including bulbs, leaves, and roots; also acorns. May also include snails, fresh-water clams, shrimps, frogs, and even fish, though normally in smaller quantities. Migrates northward in early spring; fall migration begins with eastern flight in early fall. Speed, 45 m.p.h.

Flesh almost equal in quality but not in quantity that of canvasback, particularly when feeding has been largely on plants. Numbers much fewer than they were formerly. Feeds either diving in deep salt or fresh water, or dabbling in shallow water.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Aythyinae

Ring-necked Duck, 150
Aythya collaris

Length to 18 in., including $3\frac{3}{4}$ -in. tail and 2-in. bill. Wingspread to 30 in. Duck smaller than drake. Like scaups but with black back, black head and fore parts, light gray sides with white triangle at front, bill with 2 white rings. In flight, shows broad gray wing stripe and black back. Duck brown, with gray wing stripe, white belly, and white eye ring.

Breeds from central British Columbia through Alberta, Saskatchewan, Manitoba, and western Ontario to central Arizona, northern Nebraska, northern Iowa, southern Wisconsin, and northern Michigan. Winters from southern British Columbia along Pacific Coast to Mexico and from northern Arkansas and Chesapeake Bay to Bahamas, Mexico, and Guatemala. Sometimes north to Nova Scotia.

Nests on marshy borders of lakes or pools. Nest of grass, with finer plant material and down lining. Breast feathers in down, white, or gray with white tips. Eggs 8-12, $2\frac{1}{3}$ by $1\frac{3}{5}$ in.; smooth to somewhat glossy, olive-buff. Nesting season June-July. Incubation by duck. Downy young very light colored, with lead-colored feet and yellow-tinged toes.

Food, frogs, snails, small water insects, and seeds, shoots, and roots of tender aquatic plants. Food procured by diving, tail being spread and deflexed when head is dipped under water. Flies rapidly in small scattered groups; prefers rivers and shallow waters to larger deeper lakes. In courtship, gives sound like blowing through a tube.

Classed with scaup ducks, which it closely resembles in general color, size, and behavior. Black back of male is always distinctive but ducks are easily confused, particularly with bluebills, with which they may be in a flock.

Canvasback, 147
Aythya valisineria

Length to 2 ft., wingspread to 3 ft., bill $2\frac{3}{4}$ in. Weight, drake to 3 lb.; duck to 2 lb. 6 oz. Bill longer than head, continuing profile into a narrow low-browed wedge. Drake with head and neck chestnut, breast black, and body mostly white. Duck head and neck brown, body grayer. Rump black in both sexes.

Breeds from central Alaska to Wisconsin, south to New Mexico. Winters from southern British Columbia to New York, south to central New Mexico and Florida. Reported from Pleistocene of Oregon and Florida. Found in great rafts on lakes when at peak of abundance. Not nocturnal.

Male courts duck by throwing back head and by some pursuit. Nest of weeds surrounded by water, down-lined. Eggs 7-15, olive gray, $1\frac{3}{4}$ by $2\frac{1}{2}$ in., often with eggs of redhead and ruddy duck mixed in. Incubation by duck, 28 days. Young deep yellow but, when immature, resemble duck. 1 annual brood, beginning in May-June.

Food largely water plants or grain, but may feed on decaying fish, in which case flesh is not good for man. Young birds develop feathers in 10 weeks. Molt in late July-August with wing molt in October prior to southern migration. Flight often in V-shaped formation taken by geese.

Possibly most valuable of game ducks. Flesh superior when food has been wild celery (*Vallisneria*, p. 102). May survive shore hunting because of ability to dive and feed offshore, but illegal market hunting, drought, and overshooting have seriously decreased numbers. Good canvasback shooting grounds have high commercial value.

Bluebills, 148, 149
Aythya marila

1. Greater Scaup
A. marila
2. Lesser Scaup
A. affinis

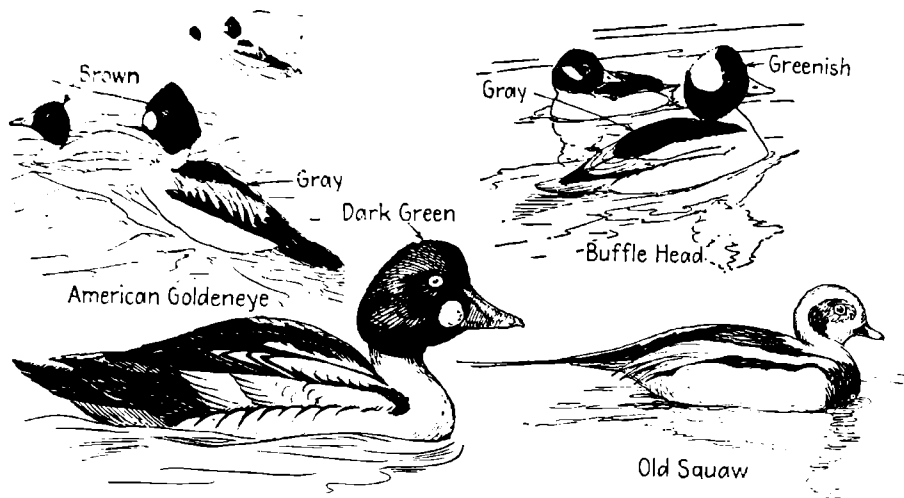
(1) drake, length $18\frac{1}{2}$ in., wing $8\frac{3}{4}$ in., weight $2\frac{3}{4}$ lb.; duck, length $17\frac{1}{2}$ in., wing $8\frac{1}{4}$ in. Both with long white wing stripe, in flight. (2) drake, length $16\frac{1}{2}$ in., weight, 2 lb.; duck, size of drake. General appearance, at distance, of black and white ducks.

(1) breeds in Arctic America, mostly west of Hudson Bay. (2), from southern Alaska to southeastern Canada, south to Colorado and Ohio. (1) winters south to Mediterranean, Florida, and Lower California; (2), southern British Columbia to New Jersey, south to Panama (2) from Pleistocene. Open-water species.

Nests usually in marshes and over water. Eggs 6-11, olive brown, $2\frac{1}{2}$ by $1\frac{3}{4}$ in. (1); $2\frac{1}{4}$ by $1\frac{1}{2}$ in. (2). Incubation 3-4 weeks, by duck. 1 annual brood. Sometimes more than one female will share a single nest, bringing egg total up to 22 and a spectacularly large number of little ducklings.

Food gathered occasionally at night where they assemble in great rafts at sea to come in over mussel beds and feed. In summer, feed largely on water plants which help make the early fall bird palatable though hardly a delicacy. Flies in an irregular formation, somewhat like a wedge.

A popular game bird because of great numbers but not excellent for table except on inland waters. From the side, drakes appear somewhat like canvasbacks but dark backs offer conspicuous difference. Ducks have white area around base of bill or on face, unlike other American ducks.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Aythyinae

American Goldeneye, 151
Glaucionetta clangula

Length to 23 in., wingspread to 32 in., tail 11 in., bill $1\frac{2}{3}$ in. Weight to 2 lb. 5 oz. Drake larger than duck; white, with black back and black to glossy green head, with white spot before eye; shows large white patches in flight. Duck gray, with brown head, white collar and large square white wing patches.

Breeds from Yukon in Alaska to Labrador and Newfoundland and south to northern New England, North Dakota, and interior British Columbia. Winters along Atlantic Coast from Maine to South Carolina and on Pacific from Aleutian Islands to Lower California or rarely to Arizona, Texas, Gulf Coast, Florida, and Bermuda.

Nests in forested country about lakes and streams, in hole in large tree, 6-60 ft. above water; down-lined. Eggs 6-12, pale green; $2\frac{3}{4}$ by $1\frac{3}{4}$ in.; often piled in nest in 2 layers. Incubation 26 days, by duck. Young sometimes safely jump alone 12 feet to water or ground below.

Food not known well but probably largely aquatic plants; known to include eelgrass, pondweeds, dragonflies, muskies, fish, crayfish, and other aquatic organisms. In flight, a whistling sound produced by its wings and therefore called "whistler" by hunters and others.

Bird edible, being considered better than scoters or coots, but not a superior table bird. Wary bird which does not come readily to decoys and so offers a welcome sporting challenge to hunters.

Bufflehead, Butterball, 153
Glaucionetta albeola

Length to 15 in., wingspread, 25 in., tail $3\frac{3}{5}$ in. Weight to 1 lb. Duck smaller than drake. One of smallest wild ducks. Drake mostly white, with large black head marked by white from eye to back of head and black back; wings with large white patch. Duck shows large dark head, with small white cheek and white wing patch.

Breeds from British Columbia and Yukon Territory to James Bay (formerly to New Brunswick) and south to Montana (formerly to Maine and California). Winters from Aleutian Islands to Maine and south to Lower California, Texas, and Florida; also in Greenland, Hawaii, Cuba, Puerto Rico, and Bermuda. Known from Pleistocene in Oregon.

Nests in wooded country where there are lakes and streams. Nest in hollow tree or rarely in ground burrow, feather-lined. Eggs 6-14, olive green to creamy white, 2 by $1\frac{1}{2}$ in. Incubated by duck without help of drake. 1 annual brood. Young become mature in about 17 months. A summer molt in July-August.

Food procured by diving, usually in small companies. May overtake and eat small fish under water. Food varies with season and region occupied, from marine animals to fresh-water plants; apparently feeds more on animal matter than on plants, particularly in winter. Flight swift and direct, with steady wing beats.

Bird is not large enough or abundant enough to be important as a source of food; when it has been feeding in a marine environment it is even more inferior because of a pronounced fishy taste. An attractive bird which should not be completely destroyed.

Old-squaw Duck, 154
Clangula hyemalis

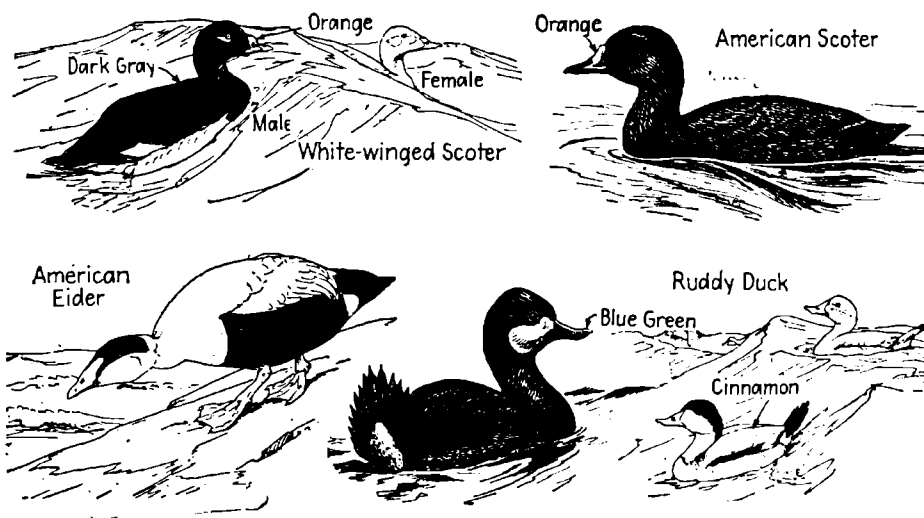
Length to 23 in., including 10-in. tail and 1-in. bill. Wingspread to 30 in. Weight, drake to $2\frac{1}{2}$ lb., duck to $1\frac{3}{4}$ lb. Drake, in winter, head, neck, and belly, white; breast, back, and wings, black, with long pointed tail feathers; in summer, dark-brown with white on flanks and belly and around eye. Duck without long tail feathers of drake.

Breeds along arctic coasts of both America and Eurasia, south to Strait of Belleisle, Southampton Island, and shores of Hudson Bay over barren Canada to southern Yukon Territory and British Columbia. Winters along Atlantic Coast from Chesapeake Bay to Florida, and along Pacific from Aleutian Islands, sometimes to southern California.

Nests on ground, not far from water, in hollow sheltered by vegetation, lined with grass and small dark light-centered down feathers. Eggs 6-10, $2\frac{1}{4}$ by $1\frac{1}{10}$ in.; gray-green to gray-olive. Nesting period May-June. Incubation 25 days by duck. 1 annual brood. Downy young blackish-brown above with creamy spot before eye and brown breast.

Food, small mollusks, crabs, shrimps, and probably some fish as well as seeds, shoots, buds, and fruits of water plants. Can dive to phenomenal depths (reported 180 ft.) but can hardly thrive where diving to much over 30 ft. is necessary. In flight, may rise in flocks in great circles almost out of sight and descend in zigzag courses.

Ordinarily flesh of these birds is too fishy to be relished as food even though they are shot as are other ducks. Properly prepared, they may be edible or even palatable but their numbers over much of their range are rarely sufficient for them to be considered important as a game duck species.



PHYLUM CHORDATA. CLASS AVES
Order Anseriformes. Family Anatidae. SWANS, GEESE, DUCKS
Subfamily Aythiinae Subfamily Erismaturinae

American Eider, 160
Somateria mollissima

Length to 26 in. Wingspread to 42 in. Weight to 5 lb. 5 oz., with female smaller. Male has white back and black belly, with top of head gray, upper breast and throat white. Female brown, uniformly streaked around body with darker brown.

Breeds on coastal islands of Labrador, Newfoundland, eastern Quebec, Nova Scotia, and Maine and along shores of James Bay. Winters from Newfoundland and Gulf of St. Lawrence to Massachusetts and even to Virginia. Related king eider has black back and ranges through Arctic Canadian coasts to Siberia, western Europe, and even into Mediterranean.

Nests in communities, on rocky sea-shores, on ground, sheltered by rocks or plants, of mosses and sticks, with heavy down lining. Eggs 3-7, 3.1 by 2 in.; pale olive green. Incubation 26 days, by female. 1 annual brood, reared in June-July. Ducklings plain dark gray-brown but paler beneath. Mature plumage in third year.

Sluggish fliers, usually low over salt water and only rarely away from rocky coasts. King eider appears to be white in fore parts and black in rear parts and whole bird appears chunky. Food essentially mussels and similar marine animals gathered largely by shallow diving. Seaweeds may be eaten but not commonly.

Food value low, as only flesh of young is edible. Eggs eaten by natives but these are gathered only from nests with excessive numbers. Down is so valuable that much effort is expended in encouraging eiders to nest in a given area. Eider down used in making sleeping bags, comforters, and arctic clothing because of lightness and insulating qualities.

1. American Scoter, 163
Oidemia nigra

2. White-winged Scoter, 165
Melanitta fusca

(1) length 21½ in., wingspread 35 in.; duck smaller than drake. Plumage entirely black in drake with bright yellow base to bill. Duck dusky brown, with white patches on either side of head. (2) length 23 in., wingspread 41½ in. Blackish, with white wing patches.

(1) breeds around most of Arctic Circle, south to Newfoundland. Winters from Maine to Florida, Aleutians to southern California, Gulf Coast, and China. (2) breeds from Alaska to Ungava, south to Washington, North Dakota, and Gulf of St. Lawrence. Winters on coast, Gulf of St. Lawrence to Florida and Pribilof Islands to Lower California.

By May, American scoters arrive on breeding grounds. Nest well-concealed in grass, on banks, with down lining. Eggs 6-10; pale yellow, 2½ by 1¾ in. Incubation probably 4 weeks by female. 1 annual brood. Individuals molt at any time of year. Young dark-brown, with white throat. Adults molt in fall.

Food largely mussels, clams, scallops, and similar shellfish taken by diving to depths of 40 ft. May fly inland, in long loose flocks, to feed on fresh-water shellfish when sea is too rough. Excellent swimmer and diver; good flier but rather helpless on land. Generally less suspicious than most ducks.

Inferior as food because of animal diet, though if entrails are quickly removed and birds are cooked properly, they may be considered edible. Great flocks over shellfish beds may do some damage. 75% of food of white-winged scoters may be mussels. Difficult to kill and more difficult to get when wounded because of diving ability.

Ruddy Duck, 167
Erismatura jamaicensis

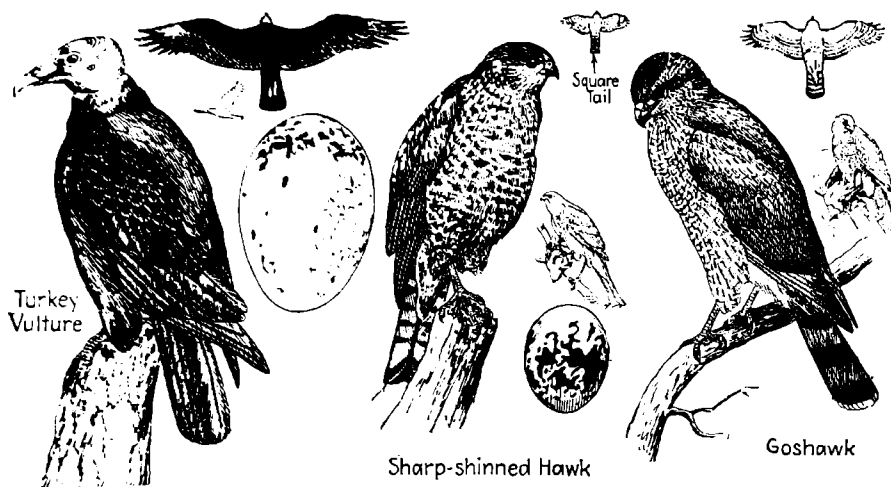
Length to 17 in., wing 5½ in., wingspread to 24 in., tail 2¾ in. Weight: drake 1¾ lb., duck smaller. Breeding male with conspicuous white cheeks, black crown; mostly rusty red, with fan-like short tail and large blue bill; in winter, cheeks gray, rest of plumage brown. Duck like winter male, but with darker line across light cheeks.

Breeds from central British Columbia to northern Illinois and south to northern Lower California. Occasionally in New England, New York, and Guatemala. Winters from Massachusetts to West Indies along Atlantic and from British Columbia to Guatemala along Pacific and south of Illinois and Pennsylvania. Known from Pleistocene.

Drake has elaborate head-shaking, tail-spreading courtship. Nest of reeds, in vegetation, over water, commonly basket-like and sometimes floating. Eggs 5-15, rough, gray-white to brownish; 2½ by 1½ in. Incubation by duck, about 30 days. 1 brood in north. Possibly 2 in South.

Food probably mostly aquatic plants, such as wild celery, pondweeds, duckweed, and rushes; also insects and other invertebrate animals. Southern migration begins in August and most flying is done by night. When swimming, may ride low in water.

Formerly, this was an important market bird in East when market hunting was possible. It was popular as "squab canvasback" but has been practically eliminated as a game bird in this area. It is still abundant along the Pacific Coast in such places as San Francisco Bay.



PHYLUM CHORDATA. CLASS AVES
Order Falconiformes

Family Cathartidae

Turkey Vulture, 325
Cathartes aura

Length to 32 in., wingspread to 6 ft., tail 1 ft. Weight to 5 lb. Sexes about equal in size. Both show small red heads, but young birds have black heads. General appearance black, except that tail and rear margins of wings in flight show lighter. Legs and feet dirty gray. Shafts of tail feathers pale brown or yellowish.

Breeds from southern British Columbia through Wisconsin and southern New York to Connecticut and south to Gulf Coast and southern Lower California. Winters except in extreme northern part of nesting range. Related races found in Mexico, Central America, South America, and Cuba. Occasionally as far north as Newfoundland.

Nest in hollow log, stump, or on ground among brush and rocks. Eggs 1-5, dull white with chocolate markings; 2½ by 2 in. Incubated for 30 days by female. 1 brood a year. Young at first covered with white down; first plumage molted in August. Young apparently mature first winter. Life span to 118 years.

Food essentially carrion, detected by sight, often from a great height. Little if any evidence that sense of smell is used to locate food. Birds roost together in good-sized flocks at night. When wounded, eject putrid stomach contents at enemy most effectively, or play dead. Speed, 21 m.p.h.

Highly valuable as a scavenger, particularly in warmer parts of range, and for this gets deserved protection. In flying or soaring, commonly holds wings considerably above line horizontal with body. At a distance soaring turkey vulture appears more headless than bird with which it might be confused.

Sharp-shinned Hawk, 332
Accipiter striatus

Length to 12 in., wingspread to 23 in., tail 7 in. Female larger, with length to 14 in. Weight: male 3½ oz., female 8¼ oz. Larger and slimmer than sparrow hawk or pigeon hawk. Tail long, slender, and square-tipped, rather than rounded as in larger, longer winged Cooper's hawk.

Breeds from northwestern Alaska to Newfoundland and south to northern Florida and southern British Columbia. Winters from southeastern Alaska to New Brunswick and south to Panama and Guatemala. Related races in Cuba, Haiti, and Puerto Rico. Known from Pleistocene of California. Essentially a woodland species.

Nest usually high in tree, of loose sticks, about size of crow's nest, about 6 in. deep, sometimes bark-lined. Eggs 3-6, bluish-white to cream, spotted with chocolate, 1½ by 1½ in. Incubated 21 days, by female. Young downy, blind, helpless when hatched, assuming adult plumage in 2 years. 1 brood a year.

Food largely birds and insects. Over 1,000 stomachs examined showed 884 containing other birds, 16 poultry, 45 insects, and 28 mammals. Known to kill large numbers of grasshoppers and moths. Brave in attack, even on larger birds. Flight with quick wing beats and alternate sailings. Call a repeated *quee*.

Ordinarily not protected by law but probably is less destructive than is assumed by many persons. Profits by vermin campaigns which remove more conspicuous hawks from competition. Probably may be considered as "vermin" if name can be applied to so small a bird.

Square tail

Sharp-shinned Hawk

Goshawk, 334
Accipiter gentilis

Length 22 in., wingspread 44½ in., tail 10 in., wing 13 in. Weight to 4 lb., female larger. Tail white-tipped. Wings with 4-5 dark bands below. Upper parts bluish-slate. In flight appears like a short-winged, long-tailed, blue-gray hawk with light gray breast; larger than a crow. Young brown instead of slate, breast streaked.

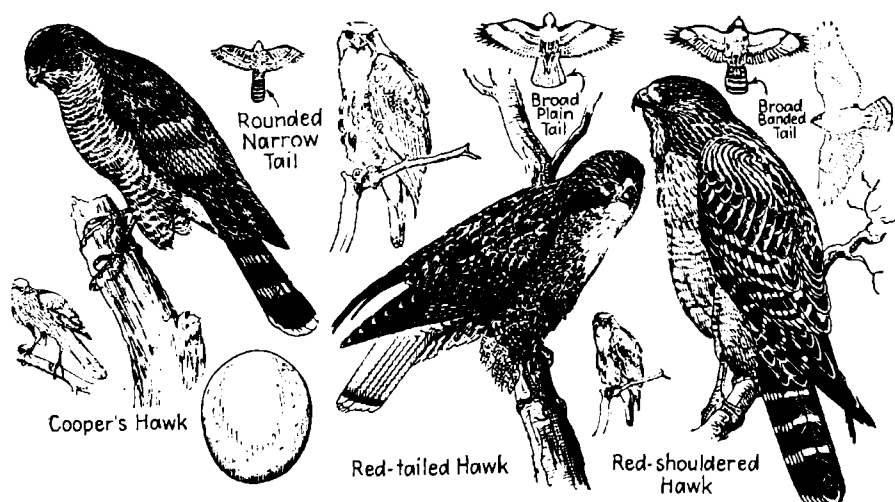
Woods or in open. Breeds from northwestern Alaska to northern Ungava and south to New Mexico and Pennsylvania. Winters in southern part of nesting range and south to Virginia, Texas, northern Mexico, and southern California. Also in Idaho, Arizona, Florida, Ireland, and England occasionally. In California Pleistocene.

Nest in larger trees; a huge pile of sticks. Eggs 3-5, white or pale blue, 2½ by 1½ in. Incubation by female, about 28 days. Young at first blind, downy white, and helpless, eating animal matter from first. Assumes adult plumage by 1½ years but is not fully mature until autumn of third season. 1 brood a year.

Of 881 stomachs examined, 441 contained poultry and game, 233 mammals, largely mice, 49, other birds. Usually waits in some tree or thicket where it is inconspicuous and flies suddenly into open to attack prey, which is caught so quickly that frequently slower flying, more conspicuous species get the blame. Active in daytime.

Probably most destructive of hawks. Pennsylvania, with a \$5 bounty, killed 80 in 1929 and 1,090 in 1937, demonstrating ineffectiveness of bounty system. Goshawks are protected in 10 states and they seem to increase as the more valuable, more conspicuous species are killed off by ill-advised "vermin" campaigns.

Goshawk



PHYLUM CHORDATA. CLASS AVES
Order Falconiformes. Family Accipitridae. KITES, HAWKS

Cooper's Hawk, 333
Accipiter cooperi

Length to 20 in., wingspread to 3 ft. Female much larger than male. About size of crow but more slender. Tail long, distinctly rounded, as contrasting with square-tipped tail of smaller sharp-shinned hawk. Wings stubby. Flight, alternate flapping and sailing. Average Cooper's hawk weighs twice as much as average female sharp-shinned hawk.

Breeds from southern British Columbia to southern Quebec and south to northern Mexico. Winters from southwestern British Columbia and Washington to California, New York, and southern Maine to Costa Rica. Active in daytime, following migrations of smaller birds and taking its toll of them.

Nests usually in tall tree. In country where trees are low, may nest on ground. Nest a loose pile of coarse sticks. Eggs 3-6, pale bluish-white, often brown-spotted, $1\frac{1}{2}$ by $1\frac{3}{4}$ in. Incubation by female, 24 days. Young blind, downy, and helpless when hatched but soon covered with white down; molts similar to those of sharp-shinned hawk.

Food largely birds. One of worst enemies of small birds and poultry. Of 422 stomachs examined, 78 contained game birds and poultry, 146 other birds, 65 mammals, 6 other animals. Powerful enough to kill ducks, rabbits, and grouse. Call, a *cuck, cuck*.

Possibly best entitled of all hawks to title of "vermin" and is not usually protected by law. However, it probably serves a role in eliminating weak and wounded birds and mammals. Because of its sly ways usually lets other species pay for its sins.

Red-tailed Hawk, 337
Buteo jamaicensis

Length to 2 ft., wingspread to 56 in. Weight to 4 lb. Heavy-appearing, with broad wings. Tail of adult red above and little rounded. Dusky gray above and with lighter wings; white beneath. Band across belly brown-streaked. Appears less uniformly colored from beneath than red-shouldered hawk. Male smaller than female.

Breeds from southeastern Canada through United States to northeastern Mexico in the plains, merging with western species which ranges through United States and north to tree line in Canada. Winters from Kansas to New York and south through eastern Mexico; occasionally in England. Known from Pleistocene of Florida and California.

Courts by soaring and calling, beginning in February. Mates for life. Nest of coarse sticks thrown together, 30-40 ft. above ground in tree. Eggs 2-4, dull white, irregularly marked with cinnamon brown, $1\frac{1}{4}$ by $1\frac{1}{2}$ in. Incubation 28 days, by female. Young blind, downy, helpless when hatched. 1 annual brood.

Food mainly mice, rabbits, insects, and snakes. Individuals may develop habit of killing chickens when other food is not available. Poultry and game constitute probably not over 1% of total food. A most valuable check on mouse infestations; name "hen hawk" a most unfortunate and inappropriate misnomer. Temperature, 106°F . Speed 22 m.p.h.

Essentially a useful species, except possibly around game farms. Protected by law in many states and should be in all. A shy hawk but has bad habit of perching in a conspicuous place where it may be shot easily. In flight, shows conspicuous white area on breast, with streaks to rear, and unbanded tail.

Red-shouldered Hawk, 339
Buteo lineatus

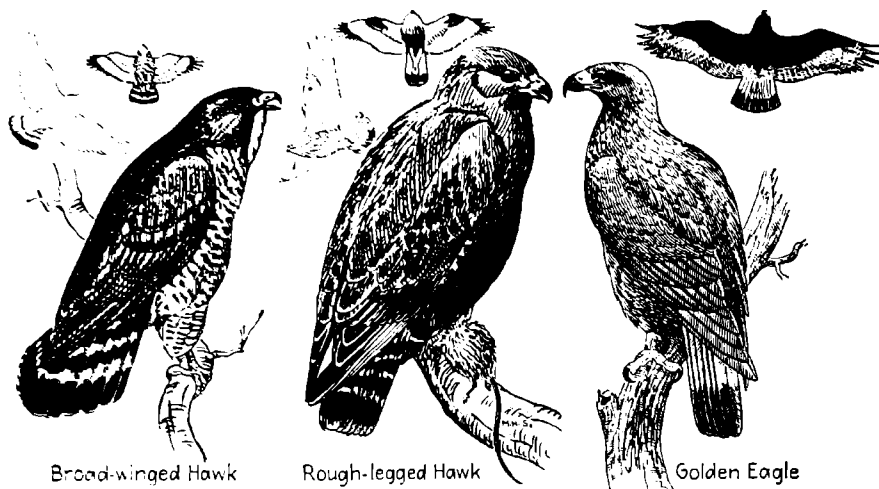
Length 23 in., wingspread 44 in., tail $9\frac{3}{4}$ in. Female larger than male. Weight to 3 lb. Gray-brown, with reddish-brown under parts. Reddish shoulder feathers and tail, with 4-5 crossbars. Appears uniform from beneath but shows a white spot just behind a dark streak, near wing tips, from above.

Breeds from Nova Scotia to Prince Edward Island and south almost to Gulf of Mexico, with other close relatives extending range into Mexico. Winters in this range and on into Mexico. Usually seen soaring high and slowly, or on some conspicuous high perch near open.

Nest a bulky pile of sticks, used year after year, in tall elm, birch, maple, or beech. Eggs 3-5, dingy or bluish-white with brown spots, $2\frac{1}{4}$ by $1\frac{3}{4}$ in. Incubated by female, 27-28 days. Young blind, downy, and helpless when hatched but assume adult plumage by 18 months. Young have less brilliant tail bars.

Food about 65% mice and other small ground animals; rarely poultry, though this is the so-called "hen hawk" so commonly killed as vermin. Of 444 stomachs examined, 287 contained mammals, 7 poultry or game, and 25 other birds. When mice and gophers are abundant, a considerable surplus may be piled around nest with young.

Possibly most useful mouse and rodent destroyer of all hawks, therefore one of the most useful species to man though one of the most tormented. Numbers of hawks increase ordinarily with numbers of mice and gophers unless they are shot off. This species is protected by laws in 24 states and should be everywhere.



Broad-winged Hawk

Rough-legged Hawk

Golden Eagle

PHYLUM CHORDATA. CLASS AVES
Order Falconiformes. Family Accipitridae. KITES, HAWKS

Broad-winged Hawk, 343

Buteo platypterus

Male, length 16½ in., wingspread 38 in. Weight 15 oz. Female, length 18¼ in., wingspread 39 in. Weight 18 oz. Tail with white band about as wide as black, but in young birds, dark bands are more numerous and may obliterate white. Tail stubbier and wings shorter than in red-shouldered hawk.

Breeds from central Alberta to New Brunswick, south to Gulf Coast, mainly east of Mississippi. Winters from southern Florida and southern Mexico through Central America to Colombia, Venezuela, and Peru; also recorded from Cuba, Haiti, and Puerto Rico. Reported from Pleistocene of Florida.

Nests usually in wooded areas in a tree, 20-60 ft. above ground. Nest well-built, lined, and hollowed. Eggs 2-4, variable; white, bluish or greenish and brown-spotted or plain; 2 by 1½ in. Incubated 23-25 days, by both parents. Young blind, downy, and helpless when hatched, yellowish-white. Adult plumage in about 18 months.

Food chiefly small mammals and reptiles. Birds in diet, most uncommon. Stomachs of 65 showed 30 with insects, 15 with mice, 13 with other mammals, 15 with frogs and toads, 11 with reptiles, 7 empty, 4 with crayfish, 2 with earthworms, and 2 with small birds. Soars very little, is unsuspicious, and perches conspicuously.

Undoubtedly a useful species to man and a victim of vermin campaigns which leave territory free from competition for less desirable species. Protected by law in many states, and should be universally protected as a mouse destroyer.

Rough-legged Hawk, 347a

Buteo lagopus

Male, length 22 in., wingspread 52 in. Female, length 23½ in., wingspread 56 in. Weight 35 oz. Seen from below, shows conspicuous black belly and conspicuous black wrist patches on wings. May show white at base of tail like marsh hawk but rough-legged hawk is a heavy, more round-tailed bird.

Breeds from Aleutian Islands to Labrador to northern Alberta, Gulf of St. Lawrence, and Newfoundland. Winters from British Columbia to southern Ontario, along northern United States border south to southern California, Texas, Louisiana, and North Carolina. Close relative to west, and from California Pleistocene.

Nests on banks near waterways. Nest to 3 ft. across, of old sticks and rotten wood, lined with grass and feathers. Eggs 2-5, variable in size and color; usually unmarked white, yellow-brown, purple, lavender, dark brown, or blotched; 2½ by 1½ in. Incubation about 4 weeks. 1 annual brood.

Food chiefly field mice and lemmings. Only 1 record of killing poultry. Stomachs of 49 showed 40 containing mice, 5 other mammals, 1 lizard, 1 insect, and remainder empty. Winter hawk which "hovers" over fields and often appears largely black. Its great size makes it seem to amateurs a dangerous bird.

One of best hawks, often and easily shot while hovering by those engaged in ill-advised vermin campaigns, particularly in winter months. One of best destroyers of mice in an open winter when cover is not available. Protected by law in some states and should be universally. Temperature 105°F.

Golden Eagle, 349

Aquila chrysaetos

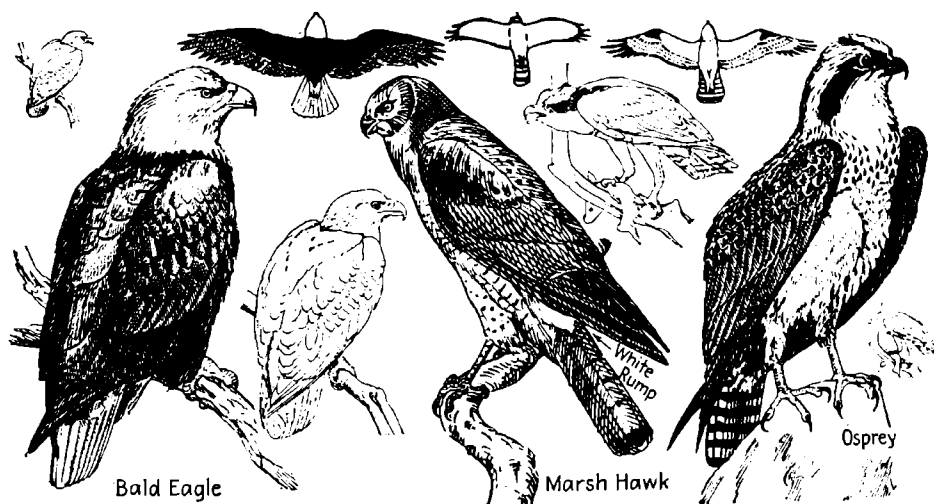
Male, length to 35 in., wingspread to 7 ft., tail 15 in. Female, length 41 in., wingspread 92 in., tail 16 in. Weight to 14 lb. 12 oz. Female larger than male. Dark-brown to black, with chocolate brown or yellow on heads of adults. In flight, shows wide-spreading upcurving wing tips.

Breeds from Northern Alaska south to northern Lower California, east through Rocky Mountains and formerly to North Carolina. Probably does not breed now east of Mississippi River except possibly in Tennessee and North Carolina. Winters south to Texas and Florida. From Oregon and California Pleistocene.

Courting sexes engage in profuse tumbling in air. Nests in forests or open. Nest a huge stick pile, to 7 ft. across and 5 ft. high. May build 2 nests. Eggs 1-4, dirty white or spotted with brown, 2½ by 3 in. Incubation about 30 days. 1 annual brood. Young helpless and down-covered when hatched, attaining adult plumage in about 18 months.

Food largely birds and small mammals, particularly jack rabbits. Unable to carry a weight in excess of 12 lb., although it can drag a larger weight a short distance. Can carry away lambs if they are left unprotected. White at base of tail and wing feathers to be found up to 5 years of age. Flight speed, to 120 m.p.h.

Most useful destroyer of gophers and jack rabbits, which are arch enemies of grazing animals because of competition they offer. Probably much more useful than injurious. Can be trained to falconry most effectively. Protected by law in at least 25 states and should be in more.



Bald Eagle

Marsh Hawk

Osprey

PHYLUM CHORDATA. CLASS AVES
Order Falconiformes. Family Accipitridae. KITES, HAWKS

Bald Eagle, 352a
Haliaeetus leucocephalus

Male length 34 in., wingspread 85 in. Female, length 37 in., wingspread, 90 in. Weight to 11½ lb. Female larger than male. Young often larger than adults; nearly black, without white head, neck, and tail characteristic of adult. Conspicuously white and brownish-black.

Range of 2 subspecies. Breeds through Alaska to Ungava and south to British Columbia and Great Lakes. Winters south to Washington and Connecticut. Southern subspecies winters and breeds through United States, to southern Lower California and central Mexico. From Pleistocene.

Courting male loops in air before female. Nest a huge pile of sticks, added to each year, in tall tree or on high ledge. Eggs 2, rarely white, with pale brown and cinnamon spots; 2½ by 1½ in. Incubation by both parents, for 30 days. Young blind, downy, and helpless when hatched. 1 annual brood. Life span perhaps 104 years.

Food animal matter, often carrion and old fish. Stomachs of 80 showed 35 with wild vertebrates, 12 with poultry. In some ways a scavenger. Unable to lift anything weighting over 15 lb. Soars majestically, high in air. Young get white feathers of head and tail in fourth or fifth year, when they mature.

This is our national bird. As such, and because of generally harmless nature, is protected by national law and specifically in many states as well. Individuals may uncommonly develop habit of killing sheep and young pigs but most reports of depredations are probably false. Provides a thrilling sight in flight.

Marsh Hawk, Harrier, 331
Circus cyaneus

Male, length 20 in., wingspread 45 in. Weight 1 lb. Female, length 24 in., wingspread 34 in. Weight 21 oz. Adult male, light blue-gray back with black wing tips, conspicuous white rump, high wing angle, and long tail and wings. Adult female brown above; streaked with brown beneath; immature birds buffy below.

Breeds from northeastern Siberia to Prince Edward Island, south to northern Lower California, southern British Columbia to southern New England and south to Florida, Cuba, and Colombia; also in Hawaii and the Barbados. Known from Oregon and California Pleistocene.

Male courts by soaring high, followed by tumble and screech. Nest on ground, in marshes and made of grasses. Eggs 4-6, dull bluish-white, 1¾ by 1½ in. Incubation by both parents, begins before full set is laid, normally 26-31 days. 1 yearly brood. Young blind, helpless when hatched; have mature plumage by 2-3 years.

Food, animal matter. Stomachs of 418 showed 250 contained mammals, 176 other birds, 11 insects, 10 poultry or game. This is "marsh harrier" which flies, alternately flapping wings and soaring back and forth, relatively close to ground. Call, a screeching *cac, cac, cac*, in breeding area, March-November.

Divided about equally as a useful species and as a destroyer of more useful species. It is rarely injurious to poultry; commonly a great destroyer of mice, but at all times an interesting bird to watch. Protected by law in many states. Conspicuous enough with white rump to be recognized as being different from other hawks.

Osprey, Fish Hawk, 364
Pandion haliaetus

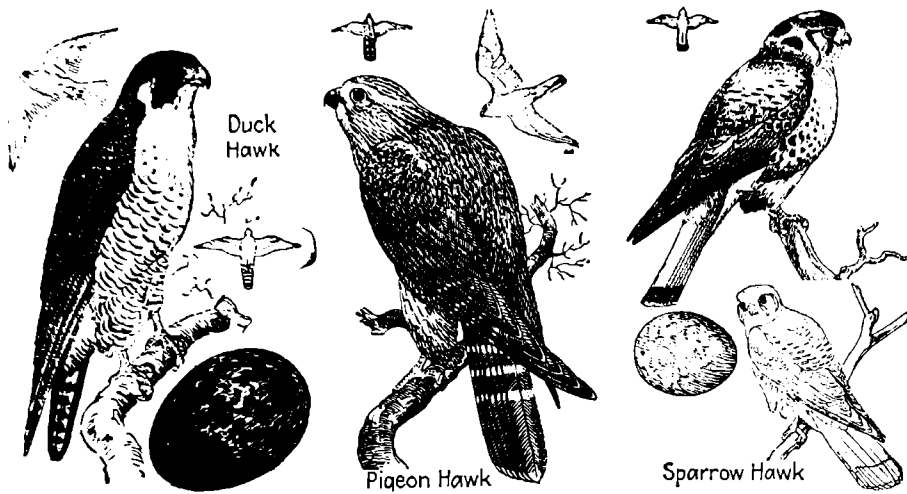
Length to 24½ in., wingspread 72 in. Female larger than male, but less difference than in most hawks. Weight: male to 3 lb., 4 oz., female to 4 lb., 10 oz. Dark-brown above, sometimes with white on top of head but not on back of neck; usually white below. Wings appear bent in flight. Hovers and plunges, striking with feet.

Breeds from northwestern Alaska to Labrador and Newfoundland, south to Lower California and Florida Keys. Winters from Florida and Gulf States through Lower California, Mexico, Central America and in Peru, Chili, Paraguay, Greenland, Europe, Asia, Australia through closely allied species. Known from Florida Pleistocene.

Nests year after year in same site, adding to old nest on pole, tree, or ground to make huge pile of coarse sticks. Eggs 2-4, dull white or buff with chocolate-brown markings, 1½ by 2½ in. Nest defended by both parents. Incubation chiefly by female, 28 days. Young blind and helpless when hatched.

Food, fish only; never takes birds, and so is desirable about poultry yards as it drives away species which might do so. Catches fish by spectacular plunge and may be robbed of its meal by more powerful eagles. Sometimes drowns when it becomes attached to fish too large to be lifted. Individuals cooperate against enemies.

Entirely useful to poultrymen and of little damage to interests of fishermen. Guides fishermen to good fishing grounds and so helps them. Few records of osprey doing any damage to game. Protected by law in at least 28 states and worthy of further protection. A thing of beauty over any large body of water.



PHYLUM CHORDATA. CLASS AVES
Order Falconiformes. Family Falconidae. CARACARAS, FALCONS

Duck Hawk, Falcon, 356a
Falco peregrinus

Male, length to 18 in., wingspread 43 in. Female, length to 20 in., wingspread 46 in. Female larger than male, blue-gray above, barred below. Tail with 6 or more narrow black bars, almost pointed. Lower half of head conspicuously black and white. Male with browner face and more conspicuous tail bars. Conspicuous contrasts of black and white on face.

Breeds from Alaska to central Greenland, and south to central Lower California, Texas, Tennessee, Pennsylvania, and Connecticut. Winters from Vancouver Island to southern New York and south to California and Panama. Occasionally in England and South America. Known from Pleistocene of California.

Mates as early as March. Nest on a high ledge or in a tall hollow tree. Eggs 3-4, buff to reddish-brown, $1\frac{3}{8}$ by $2\frac{1}{16}$ in. Incubation by both sexes, 28 days. Young white, downy, and helpless when hatched. Adult plumage assumed gradually, after first winter when juvenile plumage is molted. Falcon life span to 162½ years.

Food, animal matter. Of 102 stomachs, 70 contained other birds, 11 poultry, 12 insects. All caught by pursuit in truly phenomenal manner which wins admiration by most bird lovers. Prey caught by dropping from great height with incredible speed or by out-flying or outdodging. Flight speed, 80 m.p.h.

Food habits make it unpopular with many sportsmen but very popular with those who follow falconry. Male is called a "tercel," or "thirdling" implying that third egg produces a male. Protected by law in at least 15 states. Temperature, 106°F.

Pigeon Hawk, Merlin, 357
Falco columbarius

Male, length $10\frac{1}{2}$ in., wingspread 26 in. Female, length $13\frac{1}{2}$ in., wingspread $26\frac{1}{2}$ in., tail $5\frac{1}{2}$ in. Weight: male, 6 oz.; female, 8 oz. Like a small duck hawk but less contrastingly colored on head. Wing long, pointed, differing in this from more blunt-winged sharp-shinned hawk.

Breeds from tree limit in Canada to Alaska, Labrador, and south to Maine and northern California. Winters from British Columbia to Gulf States and south to Ecuador and northern Venezuela. 4 subspecies include Eastern, Black, Richardson's, and Western. Known from Pleistocene of California.

Nest of sticks, often in evergreen, 6-40 ft. above ground. Eggs 4-5, white with chocolate-brown markings; $1\frac{3}{8}$ by $1\frac{3}{8}$ in. Incubation 21 days. Young downy and helpless when hatched. Develop approximately adult plumage only browner by first winter; reach true adulthood second winter.

Food chiefly small birds. Of 184 stomachs examined, 141 contained small birds, 68 insects, 8 mammals, 3 poultry or game. Call, a *cac*, *kee*, or *weet*. Male is blue above; female and young are brown above. This is an exceptionally swift-flying hawk, active in daytime and a roaming migrant.

Probably most useful bird in keeping down English sparrows; not large enough to do serious damage to most poultry. This is American representative of European merlin. It is protected in at least 20 states.

Sparrow Hawk, Kestrel, 360
Falco sparverius

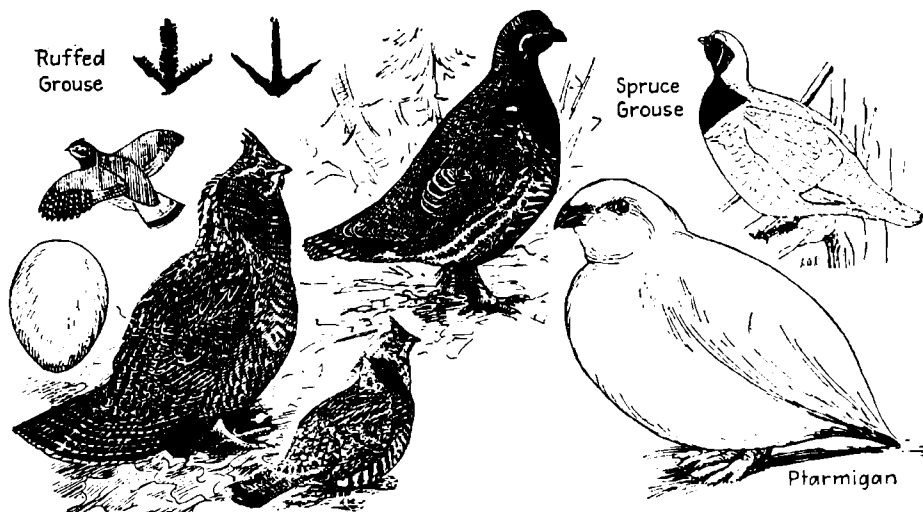
Male, length $10\frac{3}{4}$ in., wingspread 22 in. Female, length 12 in., wingspread, $24\frac{1}{2}$ in. Weight 4 oz. Female usually larger than male. Crown ash blue with conspicuous black patch on side of head. Back chestnut or cinnamon and black-barred. Tail bright red-brown, with narrow black bars. Only small hovering hawk.

4 subspecies include Eastern, Desert, San Lucas and Little sparrow hawks. Breeds from upper Yukon to Newfoundland and south to California and Lower California and Florida. Winters in southern part of range and on to Panama and Mexico. From Florida and California Pleistocene.

Courting male, hovers over mate and dives. Nests in birdhouse or hollow tree, chip-lined or bare. Eggs 3-7; buff to brownish, with finely shaded areas; $1\frac{3}{8}$ by $1\frac{1}{8}$ in. Incubation by both sexes, 29-30 days. Young blind, downy, and helpless when hatched, attain adult plumage at about 18 months. Perhaps mates for life.

Food principally mice and insects. Of 427 stomachs examined, 147 contained mammals, 69 birds, mostly sparrows, 269 insects, 29 spiders, 13 reptiles or amphibians, and 29 were empty. One contained remains of a bobwhite which may have been a wounded bird. Young birds remain in nest about 3 weeks. Speed, 25 m.p.h.

Undoubtedly a useful species which destroys large numbers of mice and insects. Makes an excellent pet but a license to keep one captive is necessary in many states. Protected by law in 23 states. Not vermin in any sense. American representative of the European kestrel. Temperature, 107-108°F.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Tetraonidae. GROUSE, PTARMIGANS

Ruffed Grouse, 300
Bonasa umbellatus

Length to 19 in., wingspread to 25 in., tail to 7 in. Weight to 29 oz. Upper parts buff to mahogany spotted with gray; under parts buff, lightly barred on breast, heavily barred on flanks. Tail with conspicuous black band near tip. Conspicuous ruff on sides of neck, larger in male. Crest on head. Compact body. Drumming sound, 40 c.p.s.

6 subspecies recognized covering territory from wooded Alaska through to Nova Scotia and south to Georgia and northern California. Eastern subspecies found from Minnesota to Massachusetts and south to Kansas and northern Georgia. Known from Pleistocene of California, Tennessee, Maryland, and Pennsylvania.

Cock courts by strutting and by vibrating wings producing drumming while on log. One cock mates with a number of females. Nests hidden from cock, in depression on ground, reasonably near an open area. Eggs 8-14, pale brown, $1\frac{1}{2}$ by $1\frac{1}{4}$ in. Incubation 21-23 days, by hen. Young able to run when hatched. 1 annual brood.

Food, acorns, beechnuts, green leaves, buds, and fruits. Young protected but not fed by hen. Subject to many diseases of poultry. Until practice of raising on wire was established, grouse could not be reared in captivity. Broods remain together into winter, ranging over 40 acres of land. Flight 35 ft. per sec., 22 m.p.h.

Possibly finest of upland game birds. Though it lacks size of turkey, yet it can supply superior sport and excellent flesh. Where undisturbed, may be unsuspicious, but where hunted is shy and alert. Suggested peak populations every $10\frac{1}{2}$ years. Eventually may be raised for freeing in woods by government. State bird of Pennsylvania.

Spruce Grouse, 298c
Canachites canadensis

Length to 17 in., tail to 5 in., folded wing to 7 in. Legs feathered to toes; lower tarsus bare in ruffed grouse. Above, barred black, gray, and brown. Tail black with reddish tip. Throat and breast black. Under parts black feathers tipped with white. Skin above eye red. Hen paler; under parts barred.

4 subspecies recognized include Hudsonian, Canada, Alaska and Valdez spruce grouse. Range from Labrador to Yukon region in Alaska, and south in Rocky Mountains to Edmonton, Alberta, and into New York and formerly in Massachusetts.

Males strut and drum. Breed chiefly in swampy, evergreen forested areas. Nest on ground, in depression at foot of tree or under bush. Eggs 8-16, variably buff with brown spots or even purplish with brown spots; $1\frac{1}{4}$ by $1\frac{1}{8}$ in. Incubation for 17 days, by hen. Young precocial. 1 annual brood.

Food in summer, largely small fruits and insects, including crickets and grasshoppers; in winter dried fruits, tree buds, shoots of spruce, larch, and fir. Seems rather stupid and has won name of fool hen because of ease with which it may be approached and shot.

Of some economic importance as a destroyer of insects. Probably worthy of much more protection than it has received. Flesh unpalatable in winter when food has been buds of evergreens and larches.

Willow Ptarmigan, 301
Lagopus lagopus

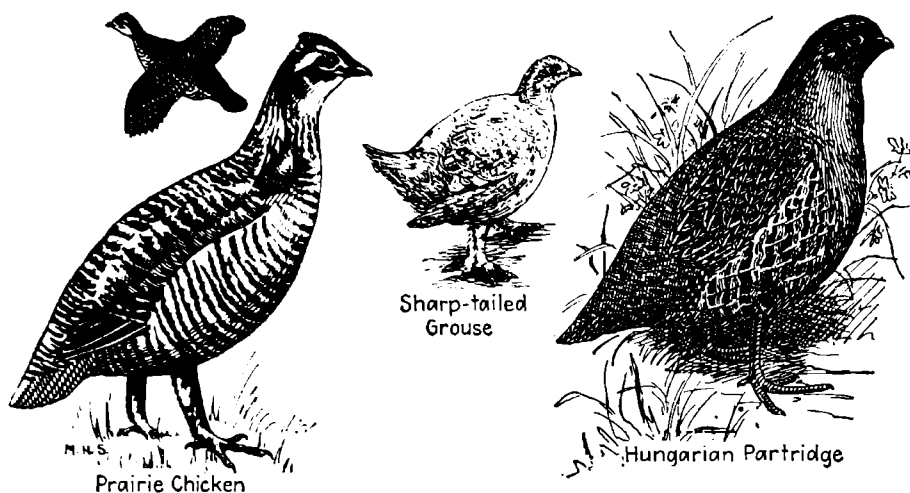
Length to 17 in., including $5\frac{1}{2}$ -in. tail and $\frac{1}{2}$ -in. bill. Like a short-tail ruffed grouse. In summer, male dark brown, heavily barred with light brown and rusty spots; tail black with narrow white tip; throat, breast, and sides, rich brown; lower abdomen and wings most white; female light brown all gray. In winter, both sexes white with black tails.

Breeds from Banks Island and west coast of Greenland to eastern Aleutian Islands and south to central Mackenzie, northern Quebec, and northern British Columbia. Winters south to central Saskatchewan, southern Alberta, central Ontario, and southern Quebec, at times into North Dakota, Montana, Wisconsin, Michigan, New York, Maine, and Massachusetts.

Nests on arctic tundra or in open areas near timber line. Nest a hollow in ground, usually lined with feathers, leaves, or bits of grass. Eggs 6-15, or rarely 20; $1\frac{1}{4}$ by $1\frac{1}{8}$ in.; deep reddish-cream color, with blotches of purple-brown which sometimes join. Nesting period early June to mid-July. Incubation 26 days, by female. 1 annual brood. Male helps guard nest and young.

Food, leaves of birch, blueberry, velvet rosemary; and in winter buds of bird willow, alder, poplar, mountain ash, and other trees. Insects, spiders, and other small invertebrate animals occasionally eaten. Most remarkable color change from winter white to summer brown with intermediate patchy coloration matching seasonal snow patches.

In the north country, ptarmigans frequently appear in large numbers and are there killed for food by natives. In this way, they provide a basic food for man in their range. Also serve a basic food for some fur bearers and for some birds of prey. They are so important that their numbers should be kept at the optimum.



PHYLUM CHORDATA. CLASS AVES

Order Galliformes

Family Tetraonidae

Prairie Chicken, 305

Tympanuchus cupido

Length to 18½ in., tail 4½ in., wing to 9 in. Weight to 2 lb. Sexes barred brown, about equal in weight but cock with long tufts of feathers on sides of neck behind a distensible orange-yellow area which is inflated during courtship. Cock also has erectable bare spots over eyes. Temperature about 109°F.

Resident from west central Alberta, southeastern Saskatchewan, and southern Manitoba to eastern Colorado, Arkansas, and formerly on to Ohio and including southern Ontario, Pennsylvania, and Kentucky. Range rapidly decreasing; now extinct east of Indiana. Related fossil species from New Jersey and Oregon Pleistocene.

Male courts many hens by booming and strutting and fights other males. Nest on ground, sheltered by grass. Eggs 16-18, buff, sometimes speckled; 1½ by 1¼ in. Incubation for 23 days, by hen. Young, in Minnesota, hatch in June and able to run quickly. Young molt in fall. 1 annual brood.

Food: animal matter such as insects, 14%; vegetable matter such as grain, acorns, fruits, and berries, 86%. In winter, hens may flock together and move to southern part of range. Species extended its range with cultivation of grain but has been greatly reduced by excessive hunting practices.

Native game bird of prairie country which should never have been allowed to decrease in numbers. With persecution, has taken to woodlands and is now commonly found there. Periodic abundance and scarcity as with ruffed grouse. A splendid game bird.

Sharp-tailed Grouse, 308

Pedioetes phasianellus

Length to 17½ in., including tail about 6 in. long and sharply pointed, middle tail feathers being about 1 in. longer than those on sides. Upper parts brown, marked and barred heavily with black. Throat light brown. Breast marked with black V's. Sides of body irregularly black and brown spotted. Abdomen white. Female smaller than male.

Breeds from central Alaska through northern Manitoba and northern Quebec to Lake Superior, Ontario, and the Saguenay River in Quebec. Irregular migrant. 2 other subspecies, the Columbian and the Prairie sharp-tailed grouse, extend range through to New Mexico, California, Nebraska, and Illinois. Essentially a resident of sand-hill type of country.

Male courts female by inflating lavender sacs near head, dancing, rattling tail feathers, and giving a bubbling sort of crow. Nests on ground with little or no modification. Eggs 11-14, creamy brown or pale olive, sometimes spotted finely with reddish-brown; 1½ by 1½ in.

Food, grains such as wheat, buckwheat, oats, sunflower seeds, and hemp seeds; buds of tamarack, catkins of birch, and twigs of hazel, with some green vegetation. Gravel must be available. A number of serious intestinal parasites, important among these being *Blastomys*, often found in intestines of dead birds.

A useful game bird but possibly doomed to extinction with introduction of the more hardy pheasants and advance of civilization; has shown some signs of increase in northern Michigan. A definite cycle of abundance and scarcity and some migration and change of range through the years.

Family Perdixidae

Hungarian Partridge, 288.1

Perdix perdix

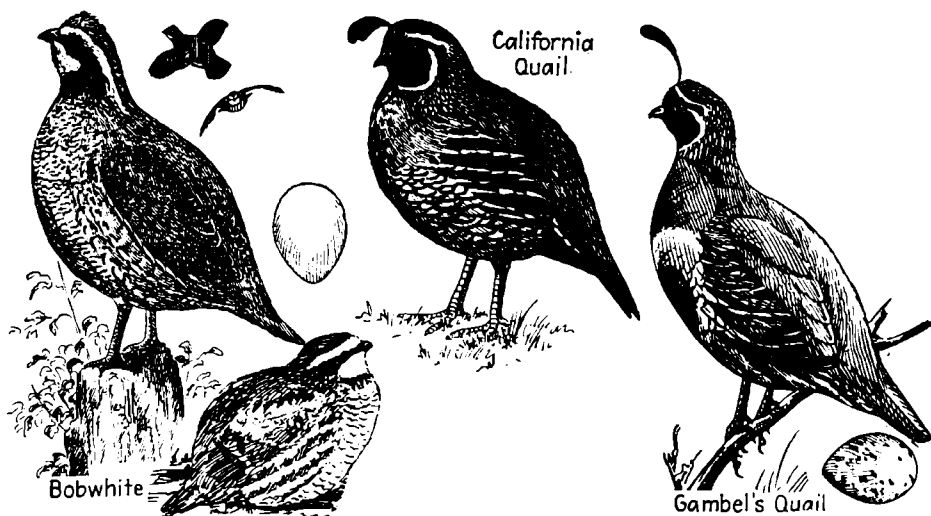
Length to 14 in., individual wing to 6½ in., tail to 3½ in. Weight to 15 oz. Male slightly the heavier. Appears in field intermediate between grouse and bobwhite. Under parts gray, with large spot of reddish-brown in adults; speckled with buffy brown in young birds.

Native of southern Sweden, Germany, and the British Isles and area into France, Switzerland, and the Pyrenees. Introduced into North America and acclimated in Saskatchewan, Alberta, British Columbia, Wisconsin, and Washington. Has not remained abundant elsewhere. Related species in Spain, Italy, Russia, and Siberia.

Male fights viciously during breeding season, does not assist in incubating eggs but does help rear young. Nest hidden on ground among grasses. Eggs, 6-18; plain olive or blue; weight, 26 g. Incubation 24 days. Young able to run soon after hatching and begin feeding on insects. Young molts to adult plumage in late fall.

Food, estimated 40.5% insects including 23% harmful species; 50% vegetable material other than grain; and only 3.5% grain; the rest miscellaneous material. Introduced as game bird, rather than as insect destroyer, though its greater usefulness may be as insect check. Flight speed, 53 m.p.h.

In Europe, is shot by thousands by so-called sportsmen who sit in comfortable chairs and have birds driven over barriers which force them to fly. This fortunately does not fit American conception of sportsmanship. May become established in America to supplement vanishing prairie chickens and quail, as buffer species. White Leg-horns might also be suggested.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Perdixidae. PARTRIDGE, QUAILS

Bob-white Quail, 289
Colinus virginianus

Length to 11 in., individual wing to 5 in. Weight to 9 oz., commonly 6 oz. Lower breast with blackish bars or U-shaped marks. Tail short. Conspicuous white throat and band across side of head, through eye, which is buffy in hen. Black on head of cock is brown in hen.

Resident. 4 subspecies include Eastern, Florida, Key West, and Texas bobwhite. Range of the 4 covers most of United States. Eastern form found from Dakota through southern Ontario to Florida and eastern Colorado. Known from Florida and Tennessee Pleistocene.

May keep mates more than 1 year though cocks fight at beginning of breeding season. Cock builds nest on ground, though several pairs may use same nest. Eggs 7-28, white, about 1 by 1½ in.; weight 18 g. Incubation by hen and by cock, 23-24 days. Average hatch, 86%. Young leave nest on hatching, reared by both parents.

Food largely injurious insects such as grasshoppers, June beetles, potato beetles, chinch bugs and squash bugs during summer; weed seeds, in winter. Winter coveys of less than 10 unlikely to withstand severe cold and wind. Individual range, 1 sq. mi. Flight speed, 85 ft. per sec., 51 m.p.h.

In some states considered a songbird. In some, annual take of an area is determined by preliminary survey and adequate breeding stock for winter survival is left. Too useful alive to be taken as game except under most intelligent management of surplus birds. Family remains together first winter. State bird of Oklahoma and Rhode Island. *Bob*, 1,645 c.p.s.; *white*, to 2,742 c.p.s.

California Quail, 294
Lophortyx californica

Length to 9½ in. Cock with black recurved topknot; upper parts smoky or dusky brown; top of head with chestnut patch bordered on front and sides by black and white lines; throat, black with white border; breast, blue-gray; flanks, olive with white streaks. Hen without black and white markings on head.

Resident in humid Pacific Coast area, from southwestern Oregon to west central California. Introduced in Vancouver Island and in state of Washington. 5 subspecies include California, Valley, Catalina, San Quentin, and San Lucas quails, most of them with a limited range compared to the California quail.

Nests on ground, in a depression, with vegetable border. Eggs to 12 or more; white or buff, spotted or marked with lavender and brown. Chicks able to run soon after hatching, and family including both parents remains together until after young are well-developed.

Food, insects and other small forms of animal life, particularly during wetter parts of year, but this diet may be to 90% grain and other plant materials though bird could not be considered a destroyer of useful plants as far as man's interests are concerned. Flight speed, 80 ft. per sec., as contrasted with 60 ft. for Gambel's quail.

Considered as a game bird. Makes an excellent pet and is the State bird of California. Its food habits are such that it is more valuable alive than dead. What sport there can be in killing such a beautiful bird is hard to see.

Gambel's Quail, 295
Lophortyx gambeli

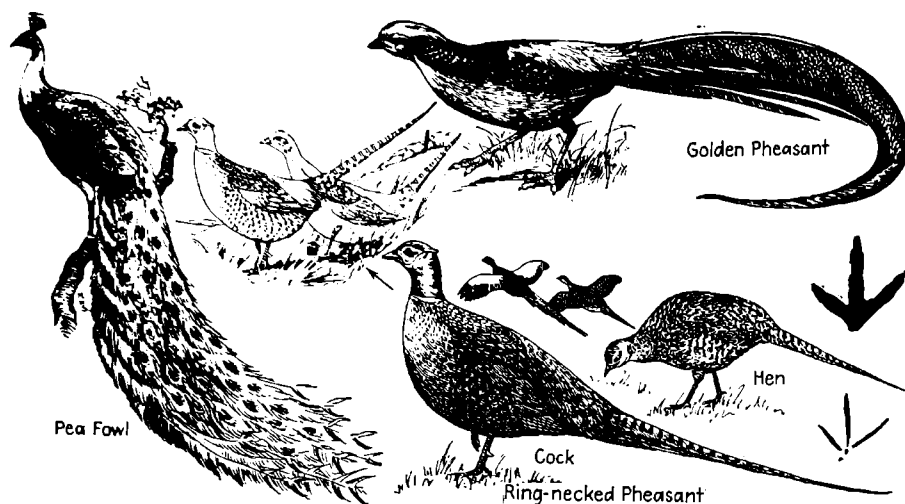
Length 10 in., including 4½-in. tail. Cock with black 1½-in. recurved plume on top of head and with black patch on buff belly; flanks brown with white streaks, crown reddish-brown, forehead and throat black with white border. Hen with 1-in. crest, and belly uniformly buffy without black patch.

Resident in hot valleys and bottom-lands of southern California and in Nevada, to Arizona and southwestern Utah with stations in Texas and Mexico, the latter in northeastern corner of Lower California and on to Guaymas, Sonora. The quail of dry desert areas as contrasted with California quail that favors humid areas. 2 subspecies.

Nests on ground, in a depression that is lined or not. Eggs 10-12, white or buffy brown, with purple or brown spots. Chicks able to run as soon as they are hatched and covey stays together until young are grown or even longer. Gambel's quail is frequently found with the scaled quail, *Callipepla squamata*, with which it may occasionally cross.

Food, January-June, almost wholly vegetable matter, including mistletoe berries, mesquite leaves, cactus fruits, and seeds of various plants. Summer food essentially insects, principally grasshoppers, the young feeding almost wholly on insects such as ants, leaf hoppers, stink bugs, and aphids. Flight speed to 51 m.p.h.

Protected by law and by coloration and by ability to escape, the Gambel's quail being a slower flier than the California quail. Large broods get good parental care during critical periods. Enemies are snakes, coyotes and, most of all, man. Useful in every conceivable way and much more valuable alive than dead.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Phasianidae. PHEASANTS

Peafowl

Pavo cristatus

Cock: length to 6 ft., including 4-ft. tail coverts; true tail hidden by coverts but supports them. Head with a tuft of 24 bare-shafted, gold-tipped feathers; under parts purplish, tail brown, face white. Hen without enormous tail coverts, head chestnut-brown with crown, back brown mottled, breast brownish-black and green.

Common Indian peacock, *P. cristatus*, native of drier Burma, India, Malay Peninsula, Ceylon, French Indo-China and Java but widely domesticated. In fourteenth century, introduced into England, France and Germany. White peacock, a sport of Indian peacock. Green peacock, *P. muticus*, not widely distributed.

Cock usually maintains harem of about 5 hens. Nest on ground, concealed, of sticks and leaves. Eggs 4-20, glossy, pitted, white; 2 by 2¾ in. Hen a variable mother, so incubation in captivity often cared for by turkey, for 28 days. 1 brood yearly. Chicks should not be confined. Full plumage in 6 years. Said to live over 100 years.

Food in wild, grain, snakes, other reptiles, seeds, and insects, but in captivity similar to that used for pheasants. Pea fowl is unfriendly to other domestic birds and often kills young chickens. Rarely moves rapidly. Voice harsh and disagreeable. Plumage is shed yearly, with annual molt.

Of no great value except as an ornamental bird. Formerly thought of as emblem of immortality and served as food at special banquets, tongues and brains being considered special delicacies. Mohammedans of Malay region consider peafowl "unclean" as it was supposed to have guided the serpent to the Tree of Knowledge.

Golden Pheasant

Thumalea picta

Cock with long full crest of hairy feathers and cape of feathers over back of head and neck; tail 2-3 times length of bird. Golden-yellow on cape and rump, scarlet beneath, back green, crest yellow, wings mostly black. Hen reddish, barred with dark brown, and without enormous tail.

Native of China, whence it has been introduced into Europe and other parts of world. Other fancy pheasants include Silver of China, Monal or Impeyan of India, and Argus of Malay Peninsula, last having a 3-ft. tail and lengthened ornamental wing feathers. There are also Asiatic, Horned pheasant or tragopan, and Reeve's pheasant with 6-ft. tail.

Under domestication, 1 cock is used in a pen with 4-5 hens. 2-year-old cocks and hens likely to produce most virile eggs. Young hens lay 10-12 eggs a season. Older hens may lay up to 25 eggs for a sitting. Eggs should be taken from nest until ready for sitting. Incubation 25 days. Young chicks "safe" after 3 weeks.

Young golden pheasant males have light eyes, hens hazel. Young cocks drop their "chicken" feathers at 3 months and begin to develop golden color; then should be separated from hens.

Golden pheasant may rarely cross with Chinese pheasant. Golden pheasant flesh considered better than that of silver pheasant, another fancy type. Golden pheasant raised almost entirely for show purposes and considered relatively easy to raise if space is available as it is hardy and withstands severe conditions.

Ring-necked Pheasant, 309.1

Phasianus colchicus

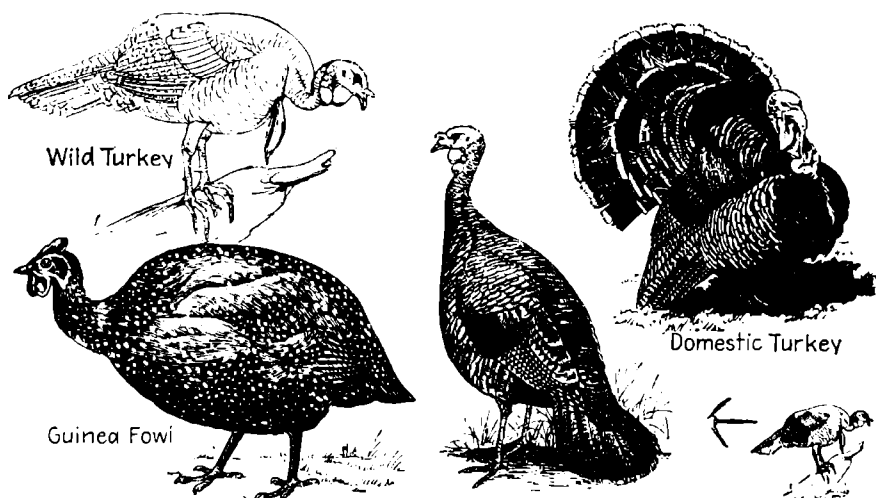
Length to 3 ft., ½ being tail in the cock. Hen about 20 in. long. Weight to 4½ lb. Male with strong spurs, brilliant coloration, white collar and ear tufts; wattles vary with season. Female brownish to chestnut, and much less conspicuous than cock in vegetation. Both sexes remarkable hiders. Temperature, 106-108°F.

Native of eastern China, from Canton to the Yangtze. 4 races introduced, mingled, and established particularly in grain areas of United States, England, and other parts of world. Minnesota, Iowa, and South Dakota becoming big pheasant states. Closely related species reported from Oligocene of Oregon and Nebraska Miocene.

One cock may control to 7 hens, fighting cocks of his own kind and domestic roosters. Nest in grasses, on ground, made by hens. Eggs 6-12; olive-buff; 1¾ by 1¼ in. Incubation by hen only, 23 days. Young cared for by female until fall when molt takes place and sex differences are obvious. 1 annual brood.

Food, a variety of plant and animal substances, roughly twice as much vegetable as animal matter. Destroys great numbers of insects as well as corn and other cereals. Crowds out native game species such as quail and prairie chickens because of aggressive nature. Average Middle Western population, 1 bird per acre.

Most important of game birds because it can be reared in captivity and yet be wild when freed. Serves as buffer species to protect native forms from excessive hunting. Minnesota has annual yield of over 1 million birds. New York averages 200,000. Conservation departments maintain expensive plants to rear pheasants.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes

Family Phasianidae

Guinea Fowl

Numidia meleagris

Sexes similar. Cock has a slightly larger body, a more pronounced comb, larger wattles, and a shriller voice. General size about that of an average hen, apparently short-legged, long-necked, deep-bodied, short-tailed, with head naked and plumage slate colored and mostly uniformly dotted with small round white spots. Temperature, 110°F.

Originally developed from wild bird of West African jungles, brought to Europe by Portuguese in Middle Ages, which disappeared. 3 domestic varieties, the Pearl, the White, and the Lavender, of which the first is the commonest. East African *N. pitlorhyncha* does not domesticate easily.

Nest of grasses, hidden in vegetation, guarded by cock while hen sits. Eggs 14-24, pointed, hard-shelled, 1¼ oz., brown or yellowish-white covered by small brown spots. Incubation 28 days; chicks run with mother almost immediately. Mother rather poor caretaker.

Food, insects and seeds gathered from fields and woods by birds; requires little special feed. Chicks at 36 hours may be fed 3 times daily hard-boiled egg, with bread crumbs 1 meal, and with chick feed 2 meals. By 1 week, can get own food in fields. By 10 weeks, should weigh 1½ lb. Adult weighs to 4 lb.

Flesh periodically popular as a substitute for wild game, which it resembles in color and in taste. Early Romans considered it a delicacy and early Greeks used it at special sacrificial ceremonies. Reintroduced into Europe in sixteenth century after having disappeared earlier.

Wild Turkey, 310a

Meleagris gallopavo

Length to 50 in., tail 18½ in., wing 21 in. Weight to 40 lb. Differs from domestic turkey in having chestnut instead of white tips to tail feathers and to upper tail coverts. 2 birds interbreed freely. Normally wild turkeys weigh about 20 lb. for gobbler and 10 lb. for hen. Temperature, 109°F.

5 native subspecies recognized. Range covers from Texas and Oklahoma, east through Florida and Pennsylvania, with Merriam's turkey to southwest. Formerly wild turkeys were found in abundance through New York, New England, and southern Canada. Known from Pleistocene of Pennsylvania, Tennessee, Arkansas, and Florida. Woodland species.

Male maintains harem up to around 15 hens for which it gobbles and fights. Male does not help in incubation or rearing of young. Nest on ground, hidden carefully. Eggs 10-14, pale buff or speckled brown, 2 by 2¾ in. Incubation 28 days. Young do not eat for 2 days but can run soon. 2 or more hens commonly unite broods.

Food largely seeds, nuts, grain, and insects, depending on season and accessibility of food to cover. Since bird has to be cautious, it is not ordinarily common near habitations, though in early days turkeys used to be a pest about poultry yards of New York and New England. Can fly with great speed.

Grandest of all America's game birds; through unwise treatment been greatly restricted in range. Attempts to re-establish it as far north as Minnesota have failed. In certain states such as Texas, where "take" is managed in given areas, farmers have a steady financial income from wild turkeys, now lost to many states. Still found in Pennsylvania.

Domestic Turkey

Meleagris gallopavo

Gobbler, cock, or tom; body, breast, back and neck bronze, wings bronze tipped with black, tail black or black with bronze bars and ashy edges, large red wattles, tuft of long breast bristles. Weight to 36 lb. Hen with white edging on back feathers, without breast tuft. Weight to about 20 lb.

Varieties include the Bronze, the White of the Narragansett, the Black, and the Slate. Bronze variety usually most popular. All developed from native Mexican form, *M. mexicana*. Ocellated turkey, *M. ocellata*, from Yucatan and Central America is rare.

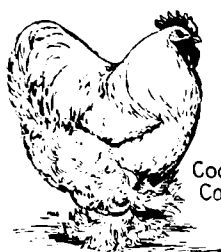
Polygamous: 15 hens for 1 young gobbler; 12 for yearling, and 8 for older. Nest on ground or in nest box. Eggs 8 to 15, 3¾-oz., light brown with brown spots. Incubation 28 days, commercially in incubator. Young birds often kept off ground and reared on wire. Gobbler may weigh 33 lb. in 1 year.

If reared on open range, turkeys feed freely on grasshoppers and other insects, may easily overfeed. Chicks require no food first 2 days; are fed boiled egg and cornbread crumbs first week; then whole wheat, hulled oats, and often buttermilk, with greenstuff. Meat scraps and grain, with vegetables, charcoal, grit, and water fed adults.

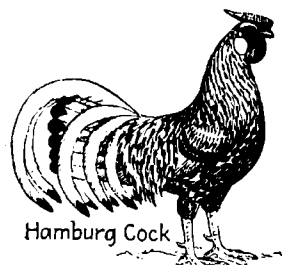
Discovery of advantages of rearing turkeys on wire revolutionized industry. Market is steadily increasing and turkeys are reared for cold storage, freezing, canning, and fresh killing. Big turkey states are California, Colorado, Iowa, Illinois, Missouri, Texas, Ohio, Minnesota, and Pennsylvania.



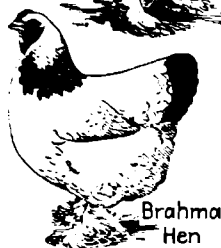
Brahma
Cock



Cochin
Cock



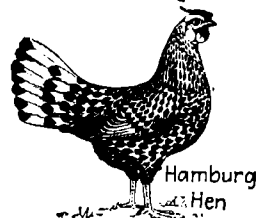
Hamburg
Cock



Brahma
Hen



Cochin
Hen



Hamburg
Hen

PHYLUM CHORDATA. CLASS AVES Order Galliformes. Family Phasianidae. FOWL

Brahma Fowl *Gallus domesticus*

Light Brahma cock: weight, 12 lb., feathers of hackle and saddle black, white-edged; main tail feathers black, sickles greenish-black, other feathers white; head medium, with crown over eyes; comb slightly serrated, in 3 rows, bright red; bill stout, curved, yellow, with dark stripe; eyes deep-set, reddish; ear lobes bright red, large, with lower edge on level with wattles; wattles bright red, medium-sized; neck moderately long, well-arched, with abundant hackle; back long, inclined slightly to middle of saddle; tail medium, carried at 35° angle; main feathers broad and overlapping; shanks yellow with feathers on outer sides; toes yellow and stout, middle and outer toes feathered. Hen: weight to 9½ lb.; hackle feathers broader and tail coverts white-laced. Cockerel: weight 10 lb. Pullet: weight 8 lb.

Asiatic breeds include Brahmas, Cochins, and Langshans. All are large birds developed essentially for their flesh. Other Asiatic breeds such as Malay, Aseel, and Black Sumatra may be smaller. Brahma breeds of fowl include 2 varieties, Light and Dark. Of these, Light is usually larger.

Asiatic fowls are among longest established. Brahmas first developed in India then introduced to China and there improved. First imported into America in 1846 and to England in 1853. Breed has improved in egg-laying qualities, rate of maturing, and appearance since. Brahmas of best type are good for both flesh and egg laying. Body is less robust than in Cochin, in spite of fact that weight may be greater. Eggs large and brown.

Cochin Fowl *Gallus domesticus*

Cochin varieties include Buff, Partridge, White, and Black.

Buff Cochin cock: weight 11 lb.; entire plumage rich golden buff; head rather short, broad, and deep; comb single, medium, with 5 points, bright red; beak short, stout at base, yellow; eyes medium, reddish-bay; ear lobes smooth, bright red; wattles long, rounded at lower edges, thin, bright red; neck short, well-arched, with abundant hackle; back short, broad, with abundant plumage; tail short, carried at 45° angle; sickles short; shanks short, heavily feathered, rich yellow; toes straight, heavily feathered, rich yellow. Hen: similar to cock except for smaller comb and hackles, shorter tail, smaller head, and generally less abundant plumage; weight 9 lb. Cockerel: weight 9 lb. Pullet: weight 7 lb.

Cochin chickens, formerly known as Cochin China chickens and as Shanghai chickens, were obviously developed in China. Breed does not long retain popularity where introduced. It was introduced into England in 1845, and in America has been used in developing other breeds of fowl. The Cochin chicken is essentially a meat-producing breed. Eggs large and brown.

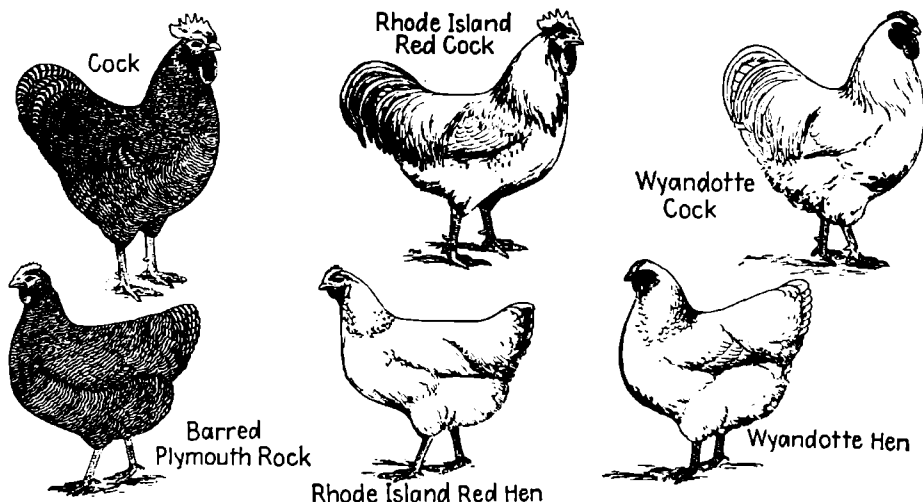
Hamburg Fowl *Gallus domesticus*

Hamburg chickens belong in a class of their own. The varieties of Hamburgs are Golden-spangled, Silver-spangled, Golden-penciled, Silver-penciled, White, Black.

Silver-spangled Hamburg cock: under 5 lb.; feathers of head white, on upper parts of body clear silvery white, ending with a broad or narrow spangle of greenish-black; head medium; comb medium, spike turned upward, bright red; bill of medium length, well-curved, dark-horn-colored; eyes large, reddish-bay; ear lobes large, flat, round, white; wattles medium, well-rounded, thin, bright red; neck tapering, with full hackle; back medium in length; tail rather long, carried at 45° angle; sickles long, well-curved; shanks medium length, lead-blue; toes straight, lead-blue. Hen: smaller than cock, with less abundant hackles, smaller comb, smaller hackle, and straighter tail.

Hamburg chickens are supposed to have been developed in Dutch Friesland (Penciled), in Italy (Spangled), and elsewhere in western Europe. They were imported into England from Holland and Belgium in 1825. Hamburgs are raised essentially as ornamentals, for show purposes. They are, in some cases, much like the Sicilian Buttercup breed imported in 1860 to America from Sicily. Eggs small and white.

Male rooster mates with female hen; 1 rooster sufficient for 20 hens. Fertile eggs may result over a period of 1 month from one mating. Fertile eggs, incubated at 103°F., hatch in 21 days into chicks. Chicks need not eat for 48 hours; roost at 1 month. Sexes should be separated at least 4 weeks. At 6 weeks, young males may be unsexed to grow up as capons. Otherwise, they become cockerels and, when sexually mature, roosters. Young females are pullets and at 5-6 months may begin egg laying. Nonbreeders are often fattened for sale as broilers at 10-12 weeks of age. Temperature, 103°-108°F. 1,000 lb. of living chickens require 8,278 cu. ft. of air to breathe each day. Life span to 15 years.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Phasianidae. FOWL

Barred Plymouth Rock
Gallus domesticus

American breeds: Plymouth Rock, Rhode Island Red, Wyandotte, Java, Dominique, and Buckeye. Varieties of Plymouth Rock: Barred, White, Buff, Silver-penciled, Partridge, Columbian, and Blue.

Barred Plymouth Rock cock: weight $9\frac{1}{2}$ lb.; grayish-white, each feather crossed by regular narrow dark bars parallel to each other and alternating with white bars of same width; head moderately large and face smooth; comb single, rather small, straight, upright, evenly serrated, with 5 points, bright red; beak stout, comparatively short, regularly curved; eyes full, prominent, reddish; ear lobes oblong, bright red, $\frac{1}{2}$ length of wattles; wattles moderately long, rounded at lower edges, red; neck, long, moderately arched, with abundant hackle; back, long, broad for entire length, rising in concave line to tail; tail of medium length, at 30° angle; sickle well-curved; shanks smooth, stout, yellow, of medium length; toes yellow. Hen: weight to $7\frac{1}{2}$ lb.; ear lobes and wattles smaller; neck shorter; tail at 20° angle. Cockerel: weight 8 lb. Pullet: weight 6 lb.

Barred Plymouth Rock was first variety of breed developed. It seems to have been developed from the Dominique breed and contains three distinct strains: the Drake (Stoughton, Mass., 1866), the Sussex County (Massachusetts, 1856), and the Upham (Connecticut, 1865).

Rhode Island Red Fowl
Gallus domesticus

Varieties of Rhode Island Red: Single comb and Rose comb.

Rhode Island Red cock: weight about $8\frac{1}{2}$ lb.; back breast, body, and neck a rich red; wings mostly red or black-tipped or black-edged; head medium, carried horizontally or slightly forward; face smooth; comb single, medium, upright, with 5 even points, bright red; beak of medium length, slightly curved, reddish; eyes reddish; ear lobes oblong, bright red; wattles bright red, medium-sized; neck of medium length with abundant hackle; back long, carried horizontally, with abundant saddle feathers; tail medium, carried at angle of 40° ; sickles abundant; shanks yellow, of medium length, smooth; toes rich yellow, straight. Hen: generally similar to cock but with smaller wattles and comb, shorter tail, and without conspicuous sickle feathers; weight to about $6\frac{1}{2}$ lb. Cockerel: weight to $7\frac{1}{2}$ lb. Pullet: weight to $5\frac{1}{2}$ lb.

The breed originated in Rhode Island early in the nineteenth century. In the heritage are known to be strains of Red Malay Game Cock, Brown Leghorn, and others. Rhode Island Reds are general-purpose birds raised for meat and for eggs. The eggs are large and brown; hatch in 21 days of incubation.

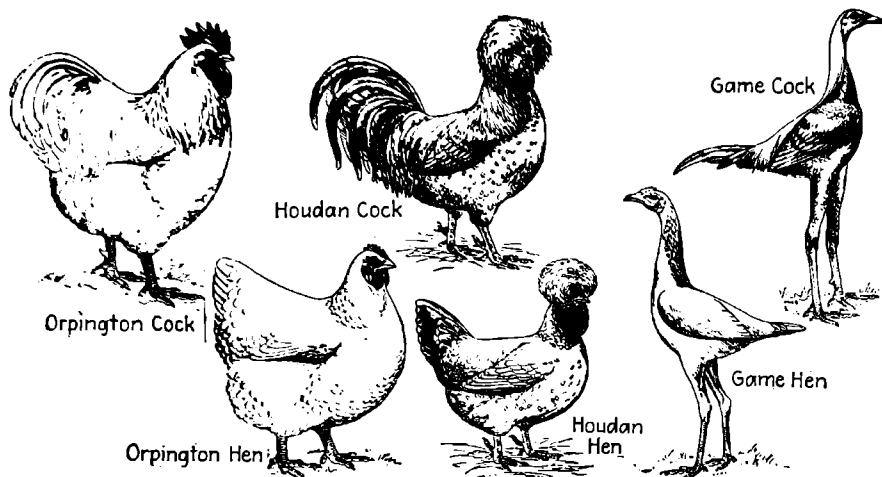
Wyandotte Fowl
Gallus domesticus

Wyandotte varieties are Silver-laced, White, Buff, Black, Partridge, Silver-penciled, Columbian, and Golden-laced.

Silver-laced Wyandotte cock: weight to $8\frac{1}{2}$ lb.; wing bows and saddle silvery white; tail feathers black; other feathers black laced with white, or white laced with black; head short and round; face smooth, free from feathers; comb rose, low, tapering to a point at rear, bright red; beak short, well-curved, dark shading to yellow; eyes oval and red; wattles bright red, moderately long; neck short, well-arched, with abundant hackle; back moderately short, rising concavely to tail, saddle feathers abundant; tail short, carried at an angle of 45° ; sickles moderately long, shanks yellow, moderately short, stout; toes rich yellow, straight. Hen: similar to cock but without white on wing bars and on back, without tail sickles, with smaller wattles and comb; weight to $6\frac{1}{2}$ lb. Cockerel: weight $7\frac{1}{2}$ lb. Pullet: weight $5\frac{1}{2}$ lb.

Wyandottes were established as a breed about 1860. Buff Wyandottes were produced by crossing White Wyandottes with Buff Cochins. Silver-penciled Wyandotte was developed through crossing of Dark Brahma, Partridge Wyandotte, and Silver-penciled Hamburg. Wyandottes are good general-purpose fowls raised for meat and for egg production. The eggs are brown, medium in size, and hatch in 21 days.

Management for flesh production calls for selection of quick-maturing strains. Most breeds weigh about 1 lb. at 2 months; 2 lb. at 3 months. If prospective broilers are fed mash first 8 weeks, they will be marketable earlier. Cockerels considered desirable for breeders should be selected at broiler age, about 3 times as many as will be needed (3 for 15 hens) being saved for further selection to 1 for 15 hens. For broilers, feed mash twice daily after 2 days old; after 10 weeks, make it available at all times. Beginning at 4 weeks, add scratch grain so that, until 3 months old, grain and mash are eaten equally.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Phasianidae. FOWL

Orpington Fowl
Gallus domesticus

Orpingtons are a breed of English class of chickens. Other English breeds are Dorkings, Redcaps, Cornish, and Sussex. 4 recognized varieties of Orpingtons: Single-comb Buff, Single-comb Black, Single-comb White, and Single-comb Blue.

Buff Orpington cock: weight 10 lb.; entire plumage a rich golden buff, richly glossed on the head, neck, hackle, and back; head of medium length, broad and deep; comb single, medium, upright, with 5 points, bright red; beak short, stout, well-curved, pinkish-white; eyes large, reddish-bay; ear lobes of medium length, oblong, bright red; wattles medium-sized, well-rounded, bright red; neck rather short, well-arched, with abundant hackle; back broad, medium in length, with abundant medium-length saddle feathers; tail moderately long, carried at angle of 45°, with medium sickle feathers; shanks rather stout, pinkish-white; toes of medium length, pinkish-white. Hen: weight 8 lb.; coloration like that of cock, with usual sex modifications in head, wattles, and tail. Cockerel: weight 8½ lb. Puller: weight 7 lb.

First Orpington developed was the Black, which originated in 1886; involved in its development were blood of Black Langshan, Plymouth Rock, and Black Minorca. Buff Orpington developed from the Buff Cochins, the Dark Dorking, and the Golden-spangled Hamburg. Orpingtons were developed for egg laying and for meat production. Eggs large and brown.

Feeding chickens for different purposes has become an art, with special rations for each purpose. A good mash mixture includes 40 lb. yellow cornmeal, 10 lb. wheat bran, 20 lb. wheat flour middlings, 10 lb. fine-ground heavy oats, ½ lb. salt, 7½ lb. dried skim milk or buttermilk, 10 lb. ground meat scrap, 2 lb. pulverized limestone, ½ lb. natural cod-liver oil. A good grain mixture for 4 weeks to maturity is equal parts cracked corn and whole wheat.

Houdan Fowl
Gallus domesticus

French class has four breeds: Houdans, Crevecoeurs, La Fleche, and Faverolles. Only 1 variety for each breed except Houdan, for which there are 2 varieties, the Mottled and the White.

Mottled Houdan cock: weight 7½ lb.; feathers black, many tipped with white; head medium-sized, carried rather high, topped by a round crest; comb V-shaped, small, resting against crest, bright red; bill moderately long, pinkish-white, mottled with black; eyes reddish-bay; ear lobes white, concealed by crest and beard; wattles bright red, nearly concealed by beard; neck medium long, with abundant hackle and a feather beard; back long, sloping toward tail; tail full, carried at angle of 40°; sickles well curved; shanks medium, pinkish-white with black mottlings; toes, 5 on each foot, pinkish-white mottled with black. Hen: weight 6½ lb.; in general, much like cock. Cockerel: weight, 6½ lb. Puller: weight 5½ lb.

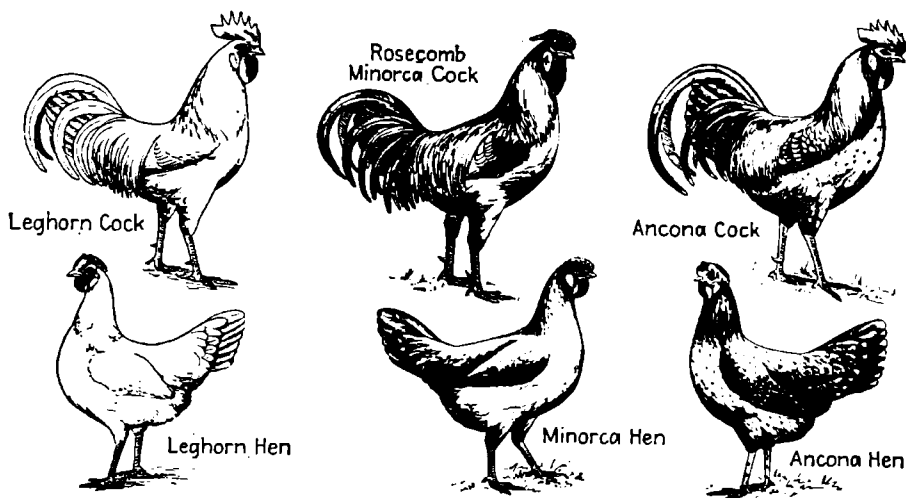
This French breed was developed in the Seine region. It was introduced into England in 1850 and into America and for some time was widespread. An egg and meat producer, but has been supplanted by other breeds which have proved superior in each respect. Eggs large and white.

Game Fowl
Gallus domesticus

The class of chickens known as Games includes Games and Game Bantams. Game varieties are Black-breasted Red, Brown-red, Golden Duckwing, Silver Duckwing, Birchen, Red Pyle, White, and Black. There are similar and other varieties for Bantams.

Black-breasted Red Game cock: breast black; hackle and saddle golden; head orange; back red; other parts mixed red and black; head long, lean, bony; comb small and single; beak long, tapering, curved, horn-colored; eyes large, keen, red; ear lobes small; wattles small and red; neck long, slightly arched, erect; hackle short and close; back short, narrow, and sloping from neck to tail; tail short, closely folded, horizontal; shanks long, bony, greenish; toes long, straight, green. Hen: lighter in color and in weight than cock.

Fighting cocks developed from many breeds. Of Asiatic breeds, the Aseel provides fighting birds of India. In British class, the Cornish provides game birds; are also superior meat producers. Fighting birds have been bred for centuries. Fortunes have been won and lost on cockfights; outlawed in England in 1849. Training and arming a highly complicated process.



PHYLUM CHORDATA. CLASS AVES
Order Galliformes. Family Phasianidae. FOWL

Leghorn Fowl
Gallus domesticus

Mediterranean class of poultry includes are bred primarily for egg laying.

Leghorn varieties are Single-comb Dark Brown, Rose-comb Brown, Single-comb White, Rose-comb White, Single-comb Black, Silver, Red Pyle, Single-comb Buff and Rose-comb Buff.

Single-comb White Leghorn cock: weight to $5\frac{1}{2}$ lb.; entire plumage white; head moderately long and fairly deep; comb single, medium in size, upright, with 5 long points, bright red; beak not long, nicely curved, yellow; eyes reddish-bay; ear lobes oval, rather broad, white; wattles moderately long, thin, bright red; neck long, nicely arched, with abundant hackle; back rather long, sloping down to tail; saddle long; tail large, carried at an angle of 45° ; sickles long and well-curved; shanks long and yellow; toes medium, straight, yellow; disposition nervous; flies readily. Hen: colored like cock but with smaller tail, comb, wattles, and without spurs, conspicuous sickle feathers, and similar evidence of masculinity. Cockerel: weight $4\frac{1}{2}$ lb. Puller: weight $3\frac{1}{2}$ lb.

Leghorn breed was developed in Italy and was introduced into America about 1835. It has since been greatly improved by breeding for egg laying and broiler-producing purposes. Ear lobes are white, whereas lobes of Asiatic breeds are red. Primarily egg layer and secondarily broiler fowl. Broilers can be grown in 8 weeks from hatching. Individuals have laid over 1,000 eggs. Eggs large and white.

Management for egg-laying: Select vigorous parents. Breeding hens to be used in January should be forced to molt by November 1 by removing food and water for 1 day then allowing hens to rest 60 days, during which they are given all the grain they will eat and all the wet mash they will clean up in 15 minutes. Pullers and hens should be kept separate to avoid disease and parasites. Cull nonproducers in September, or in July and in October. Hen may lay over 300 eggs a year. Males too must be carefully selected as breeders of fruitful hens. Masculinity, early maturity, and vigor are qualities sought. $4\frac{1}{2}$ -5 sq. ft. of floor space per chicken and 5 in. of roost space are desirable.

Minorca Fowl
Gallus domesticus

Leghorns, Minorcas, Spanish, Blue Andalusian, and Anconas. Most of them

Minorca varieties are Single-comb Black (described), Rose-comb Black (illustrated), Single-comb White, Rose-comb White, and Single-comb Buff.

Single-comb Black Minorca cock: weight 9 lb.; feathers lustrous greenish-black throughout; head moderately long, wide, and deep; comb large, single, deeply serrated, with 6 points, bright red; beak of good length, stout, well-curved, black; eyes large, dark-brown; ear lobes large, almond-shaped, white; wattles long, thin, bright red; neck rather long, slightly sloping to tail, with long saddle feathers; tail large, carried at angle of 45° ; sickles large and long; shanks rather long, straight, strong, black or dark slate; toes straight, black or dark slate. Hen: colored like cock but with smaller wattles, comb, and tail, and no conspicuous spurs; weight to $6\frac{1}{2}$ lb. Cockerel: weight $7\frac{1}{2}$ lb. Puller: weight $5\frac{1}{2}$ lb.

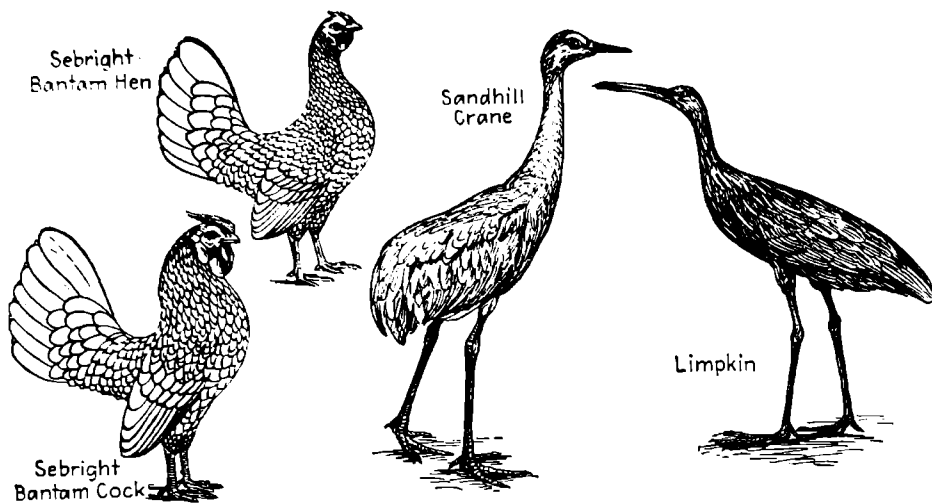
Minorcas developed in Spain; probably introduced by Moors. The Balearic Islands off east coast of Spain were site of greatest improvement. Popular in America in late nineteenth century; also popular in England. Minorcas lay large eggs of remarkable whiteness, and until the Leghorns reached their present popularity they were the egg layers of the average American farm.

Ancona Fowl
Gallus domesticus

Ancona varieties are Single-comb and Rose-comb.

Single-comb Ancona cock: weight $5\frac{1}{2}$ lb.; feathers lustrous black with about 1 in 3, on the average, tipped with white; head moderately long and fairly deep; comb single, medium, deeply serrated, 5-pointed, bright red; beak not long, yellow, with upper half shaded with black; eyes medium, reddish-bay; ear lobes medium, almond-shaped, white; wattles long, thin, bright red; neck rather long, nicely arched, with abundant hackle; back of good length, sloping a little to saddle; tail large, carried at 45° angle; sickles long, curved; shanks moderately long, slender, yellow mottled with black; toes straight, yellow, or yellow mottled with black. Hen: similar to cock except for smaller cockles, comb, tail, and other usual male characters; weight $4\frac{1}{2}$ lb. Cockerel: weight $4\frac{1}{2}$ lb. Puller: weight $3\frac{1}{2}$ lb.

Anconas are sometimes called "Mottled Leghorns." They were developed in Ancona and Italian Adriatic seaports; introduced into England in late nineteenth century and from there came to America where they have had some rather surprising popularity at certain places. Anconas are bred for egg laying, the eggs being white and medium in size.



PHYLUM CHORDATA. CLASS AVES

Order Galliformes Family Phasianidae

Family Gruidae

Order Gruiformes

Family Aramidae

Bantam Fowl *Gallus domesticus*

Silver Sebright Bantam cock: weight to 26 oz.; head large, round, held back; comb rose, square in front with spike to rear; wattles broad and well rounded; ear lobes smooth; wings carried low; back short; tail full and well expanded; breast, prominent. Hen: weight to 22 oz.; in general, smaller than cock; neck and head smaller.

Ornamental bantams include miniature Cochins and Brahmas. Black and white rose combs are miniature Hamburgs. There are also Polish bantams, white-booted bantams, Japanese bantams, and Sebright bantams, the latter illustrated. Sebrights were originated in England and include such varieties as Golden and Silver Sebrights.

Eggs of bantams are, of course, smaller than their larger counterparts described earlier. For judging purposes, bantam cockerel should be 22 oz. in weight and bantam pullet 20 oz. except that Cochins and Brahma bantams weigh 26 oz. for cockerel and 24 oz. for pullet.

Food much the same as for larger breeds discussed in previous pages. Health, physiology, enemies, and general care are also similar except that space needed per individual animal for bantam is obviously less than for a Brahma fowl.

Bantams are raised primarily for show purposes but they also are beloved by children and make excellent but often highly abused pets. Black-breasted red Malay bantams were the favorite fowls in the author's chicken yard, well able to take care of themselves with larger birds, but having privileges not extended to all the flock.

Sand-hill Crane, 206 *Grus canadensis*

Length to 4 ft., with bill to 6 in. long. Height to 4 ft. Wingspread to 7 ft. Crown and area in front of eyes naked, red. Cheeks feathered. Slate gray or light brown throughout, with darker wings and light to white throat. Young entirely feathered and more rusty in appearance.

Bred formerly from British Columbia to southwestern Michigan and south to California, Illinois, and Ohio. Found formerly in migration east to New England but now rare east of the Mississippi and over much of its range. Still breeds from northeastern California to Wisconsin and Michigan. Winters in California, Texas, and Mexico.

Courtship elaborate, with many congregating and beginning a united bowing, parading, and bouncing in which whole group will behave like bouncing balls. Nest a mass of vegetation with hollow at top. Eggs usually 2, 3½ by 2½ in.; olive buff with brown spots. Young leave nest soon after hatching.

Food, frogs, snakes, insects, and similar small animals. Flight steady and heavy but deceptive in its speed. Florida crane and little brown crane are subspecies extending range from Florida to Alaska. Whooping crane, almost extinct, formerly common over much of America, will probably disappear soon. Snow-white, with black-tipped wings and red crown and forehead.

An interesting bird without any bad habits so far as man's interests are concerned but a temptation to hunters. Descriptions of courtship of great numbers in past provide interesting reading.

Limpkin, 207 *Aramus guarauna*

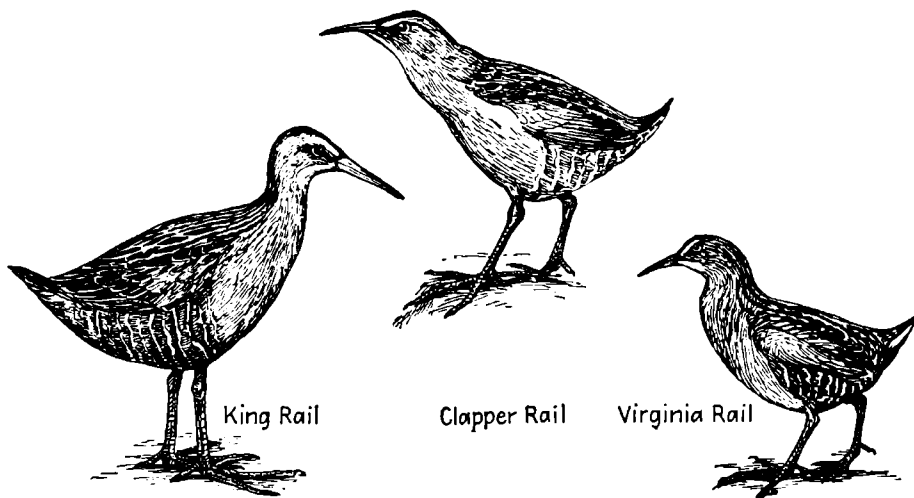
Length to 27 in., including 4¾-in. bill. Wingspread to 42 in. Dark-brown throughout, streaked with white. Bill long and curved slightly downward toward end. In flight, legs hang loosely down behind, giving bird an awkward appearance. Flight rarely long. Legs darker than in many heron-like birds.

Breeds from Okefinokee Swamp in Georgia, south through Florida. Also in Cuba. Winter and summer range are approximately same. Has disappeared from much of northern part of its range; greatly reduced in numbers elsewhere. Locally it may appear rather abundant.

Nest, if in swampland, may be 2-3 ft. above water; if in a tree region, may be as much as 17 ft. up. Eggs 3-8, 2½ by 1½ in.; grayish-white and blotched with light brown. Nesting period April-May. Young dark-gray, able to swim as soon as they leave the shell, and leave nest the day they hatch.

Food largely aquatic and marsh animals, especially large snails, collected from fresh-water areas where it lives. A relatively common bird in certain parts of Florida and because of its white-spotted appearance easy to identify. Wings and tail show a metallic bronzy reflection when bird is flying.

Probably of little economic importance but certainly is interesting. Its call of *coow* repeated resembles the cry of a person being tortured and once heard is easily recognized, imitated, and long remembered.



King Rail

Clapper Rail

Virginia Rail

PHYLUM CHORDATA. CLASS AVES

Order Gruiformes. Family Rallidae. RAILS, GALLINULES, COOTS

King Rail, 208

Rallus elegans

Length to 19 in., including $3\frac{1}{2}$ -in. tail and 3-in. bill. Wingspread to 25 in. Weight to 18 oz., female smaller than male. Sexes colored alike. Upper parts dark brown, streaked. Neck and breast cinnamon-red. Throat white. Belly and sides blackish-brown and distinctly white-barred. Young duller and darker above and paler beneath. Very young are black.

Breeds from Nebraska through southwestern Ontario to Massachusetts and south to Kansas, Florida, and Texas. Winters in southern part of breeding range, at least south of New Jersey. Found occasionally north to Maine and to Manitoba. One allied race found in Cuba. Known as a fossil from Pleistocene of Florida.

Nests in fresh-water marshes. Nest of weeds and grasses, on or near ground, just above water surface. Eggs 6-16, $1\frac{1}{8}$ by $1\frac{1}{2}$ in.; buffy to creamy white with brown or lilac spots. 1 annual brood. Nesting period June. Glossy black downy young soon develop feathers, and when feathered resemble adults.

Food largely insects such as grasshoppers but is also known to eat oats to a limited degree. Highly secretive, and more often heard calling a repeated *bup* than seen. When caught, it has been said to cry like a common barnyard fowl. Some individuals have been described as being fearless.

Not common enough to be of positive economic importance even if they lived where they could do more good. Rails are relatively easy to shoot because of their direct flight but are hard to find once they have been dropped. A live rail in a marsh is of much more interest and value than its carcass in a bag.

Clapper Rail, 211

Rallus longirostris

Length to 16 in., including $2\frac{1}{2}$ -in. bill and $2\frac{1}{2}$ -in. tail. Wingspread to 21 in. Weight to 14 oz., with female slightly smaller than male. Upper parts pale olive gray, with feathers grayish-white on borders. Tail brown. Throat white. Breast pale brown with a gray wash. Sides and abdomen brown with fine whitish bars.

6 subspecies: Northern, Yuma, Wayne's, Florida, Mangrove, and Louisiana clapper rails. Northern breeds in salt marshes from Connecticut to North Carolina and winters south of New Jersey, within its breeding range for the most part. Sometimes found north to Maine. Other subspecies extend range around Gulf Coast. Essentially a salt-marsh rail.

Nests on ground or in marsh weeds, sometimes a short distance away from salt marshes. Nest commonly covered with a canopy of weeds, concealing eggs. Eggs 8-13, $1\frac{1}{10}$ by $1\frac{3}{4}$ in.; buff or gray with brown, lavender, or reddish markings showing faintly. Incubation 14 days. 1-2 annual broods. Downy young chiefly black with some whitish areas below.

Food, small animals such as snails, insects, fish young, crustaceans, with some seeds and water plants. Call a rather hoarse, repeated *cac* beginning loudly and gradually tapering off in volume, tone, and frequency. Migrates mostly at night, flying low, and so meets many accidents.

Recognized as a game bird and in some areas is reasonably abundant, so much so that its eggs have been collected for food. In 1896, it was estimated that some 10,000 clapper rails were killed near Atlantic City, N. J., but that is not now possible; however, it does give some evaluation of game-management practices so far as these birds are concerned.

Virginia Rail, 212

Rallus limicola

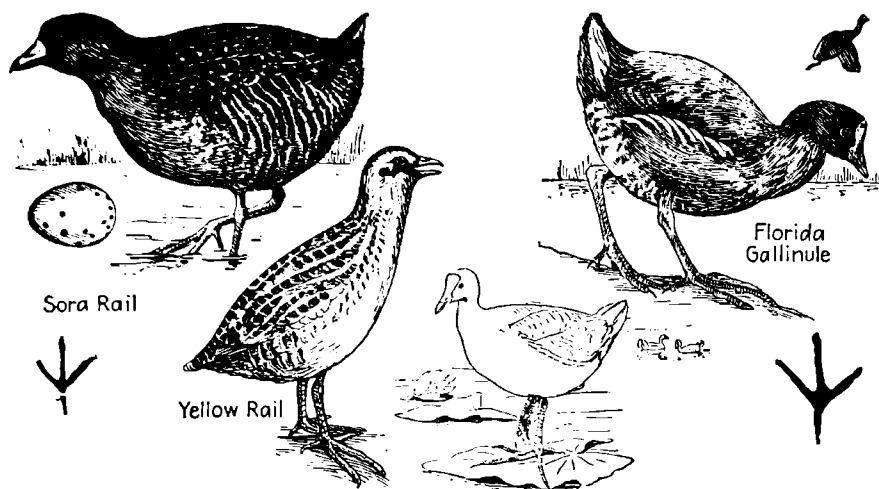
Length to $10\frac{1}{2}$ in., including 2-in. tail and $1\frac{3}{8}$ -in. bill. Wingspread to $14\frac{1}{2}$ in. Weight to 4 oz., female being slightly smaller than male. Upper parts brown to blackish, with gray-bordered feathers. Cheeks gray. Throat white. Sides and under parts brown, with blackish and white bars on flanks.

Breeds from southern British Columbia to Nova Scotia and New Brunswick, south to northern lower California, Utah, Missouri, Kentucky, and New Jersey. Winters from Utah, through lower Mississippi Valley to North Carolina and south to Florida and Guatemala. Sometimes found in Hudson Bay, Labrador, Newfoundland, and Greenland and in Bermuda and Cuba.

Nests in fresh-water marshes and along stream banks in high vegetation. Nest of weeds, well-concealed. Eggs 5-12, $1\frac{1}{8}$ by $1\frac{1}{4}$ in.; variable, from white to creamy buff, with sparse brown and purple spots. Incubation by male and female. Probably only 1 annual brood. Only rarely found nesting in salt-marsh areas. Young greenish-black, with pink bill.

Food probably chiefly insects and other small animal life of marshes, though no extended study seems to have been made. Known also to eat wild rice, wild oats, and other grass seeds. Known to give a grunting sound, a squeak, a series of hen-like *cuts*, and other sounds and is undoubtedly heard more frequently than it is seen.

A game bird hunted particularly during southern migration, when more birds may be observed than at other times. Its flight is straight and it is therefore an easy shot.



PHYLUM CHORDATA. CLASS AVES
Order Gruiformes. Family Rallidae. RAILS, GALLINULES, COOTS

Sora Rail, 214
Porzana carolina

Length to 9¾ in., wingspread 14½ in. Weight to 4 oz. Hen smaller than cock. Sexes similar in appearance. Adult with conspicuous black on face and throat; not so in young. Back olive-streaked. Breast and sides of head slate. Flight slow and steady, making easy mark for hunters.

Breeds from British Columbia to Hudson Bay and south to California and Maryland. Winters from California to Florida and south to Venezuela and Peru. Accidental in England and Greenland. Closely related Virginia, clapper, and king rails are known from Pleistocene of Florida or California.

Nests in marshes or in grain. Nest supported and concealed by grasses. Eggs 4-17, olive buff spotted with dark-brown, 1½ by 1½ in. Incubation 14 days, by hen and cock. 1 annual brood. Nesting May-June. Young black with orange throat tuft, and pink, bill with red cere. Complete molt in July.

Food, insects, small crustaceans, seeds, and grain. Southern migration usually does not begin until frost, so may be irregular though hunting seasons are not. May cross Gulf of Mexico in southern flight; has been found hundreds of miles at sea. Can swim and dive if necessary to escape or to get food.

Considered by law as a game bird. Connecticut record shows individual hunter who took 181 soras in 1 day. Federal law legalized individual hunters taking 2,530 a year when all New York hunters the same year took a total of 3,046 rails, coots, and gallinules. Obviously, legal bag limit is absurdly high.

Yellow Rail, 215
Coturnicops noveboracensis

Length to 7¾ in., including 1¾-in. tail and ¾-in. bill. Wingspread to 13 in. Weight to nearly 3 oz., female being smaller than male. Mostly yellowish but, unlike other rails, shows white wing patch in flight. Legs greenish to brown to yellow. General color streaked brown to yellow to blackish, with narrow bars and mottlings of white on flanks.

Breeds in Michigan, North Dakota, and east central California, but found during breeding season from Nova Scotia to southern Mackenzie, south to California and Massachusetts. Winters mostly in Gulf States, and from North Carolina to California. Relatively rare, found in grassy marshes and among reeds. Favors higher lands than most rails.

Nest on ground, near marshes or in them. Eggs 4-15, 1½ by ¾ in.; pinkish-brown to deep tan with chocolate-colored markings, particularly at larger end, and usually in form of small dots. By first winter and through first summer, young have fewer dark markings than adult, but by second summer they have more white bars.

Food probably same as other rails, including both animal and plant materials. In flight, it flutters a short distance only to drop into cover and run. Difficult to flush and almost impossible to collect without help of good bird dog trained for the work. Call an oft-repeated *tic* given in series of alternating 2 and 3 units.

Of little economic importance. It is difficult to understand the shooting of a bird that weighs at most less than 4 oz. for its meat. It is probably much more frequently heard than seen and so its rarity may be only apparent in many localities.

Florida Gallinule, 219
Gallinula chloropus

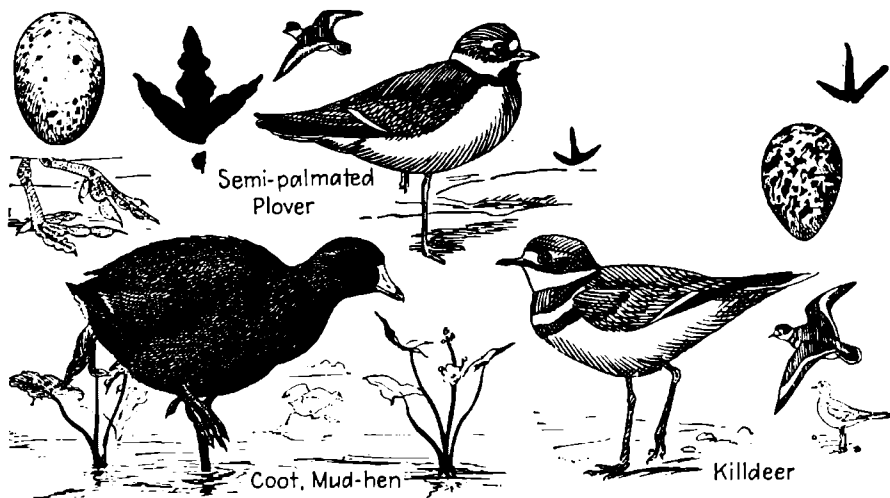
Length to 14¾ in., wingspread to 23 in. Weight to 14 oz. In field, resembles coot but bill and plate on front of head are red instead of white. Sexes colored alike. White streak appears along sides. Tail black above and white beneath. General color slate. Toes lack scalloped webs of coot.

Breeds from central California to southern Ontario and south to Lower California and Panama. Winters from southern California to South Carolina and south with related species in South America and Eastern Hemisphere. Fossil forms reported from Pleistocene of Florida.

Nests in late spring in marshlands; builds more than one nest but only occupies one; of plants. Eggs 8-17, buff and spotted, 1½ by 1½ in. Incubation 22-25 days. Young downy, black, with white-tipped, hair-like feathers at throat. Top of head bare. Bill red but black-tipped. Like adults by December.

Food, plants and animals of habitat including grasshoppers and seeds where available. When on water, floats high, and when swimming moves head like chicken. Poorer swimmer than coot but prefers to stay in plants at water's edge. Calls like clucks of hens, also explosive cackle.

Considered important game species in spite of small numbers, whole state of Minnesota yielding over 4 years an average of only 350 birds, though legal take per hunter for season was 2,530. Does no damage to man's interests and should receive more protection than it does. Bag limit ridiculously high.



Order Gruiformes
Family Rallidae

PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes
Family Charadriidae

Coot, Mud Hen, 221
Fulica americana

Length to 16 in., wingspread to 28 in. Weight to 22 oz. General appearance slate gray with darker head, neck, and tail. Bill white, and white under tail. Sexes colored alike. Feet with webs of toes like wavy-margined flaps but not connected through most of length. Eyes red. Walks with chicken-like motion of head.

Breeds from British Columbia to New Brunswick and south to Nicaragua. Winters from Alaska to Massachusetts and south to Costa Rica. Closely related races and species extend range through Europe, Asia, Africa, and Australia. Found in great rafts or flocks or singly along waterways. Fossil records from Pleistocene of Oregon.

Breeds often in colonies. Nest of plant materials hidden near water. Eggs 6-15, creamy clay-colored finely speckled with black, 2 by $1\frac{1}{4}$ in. Incubation about 27 days, but young hatch at different times, first being cared for by cock while hen sits. Young black, with orange thread-like down on head and neck and with black-tipped, orange-bills.

Food largely vegetable matter, including roots, seeds, and tubers and also some animal matter. Unsuspicious, hides rather than flying; takes to wing with great spattering of water surface. Great size of flocks during certain seasons may give false impression of abundance. Eggs edible but inferior.

Inferior table bird, easily shot. Bag limit of 25 birds a day or 1,150 birds a season is ridiculously high and probably is rarely if ever reached; daily bag could be reached easily during flock concentrations. All New York hunters combined in 1 year did not reach limit of individual.

Semipalmated Plover, 274
Charadrius hiaticula

Length to 8 in., wingspread to 16 in., tail $2\frac{1}{2}$ in. Sexes similar. Front toes partly webbed; in outer and middle toe, web reaches second toe joint. Appears brown and white below, like a short-tailed, single-ringed, half-sized killdeer. In winter, black areas are brown.

Breeds from Arctic coast of Bering Sea to Greenland and south to valley of Yukon, southern James Bay, north shore of Gulf of St. Lawrence, New Brunswick, and Nova Scotia. Winters from central California to South Carolina and south to Patagonia and Chile. Occasionally in Siberia and England.

Nest a depression in sand or gravel, on or near shore, in open. Eggs 4, pear-shaped, pale buff spotted with blue, $1\frac{1}{2}$ by 1 inch. Incubation 23-25 days, by both sexes. Young able to run soon but family stays together as do killdeer.

Food chiefly small animals such as insects, small crustaceans, eggs of marine animals, or other forms of animal life gleaned from bird's habitat. One of most characteristic and attractive of beach birds and one of best beloved. Speed, 32 m.p.h.

Too small to be of value as game. Protected by law and should have perpetual protection throughout their range, a condition which does not exist in Southern Hemisphere. A splendid companion.

Killdeer Plover, 273
Charadrius vociferus

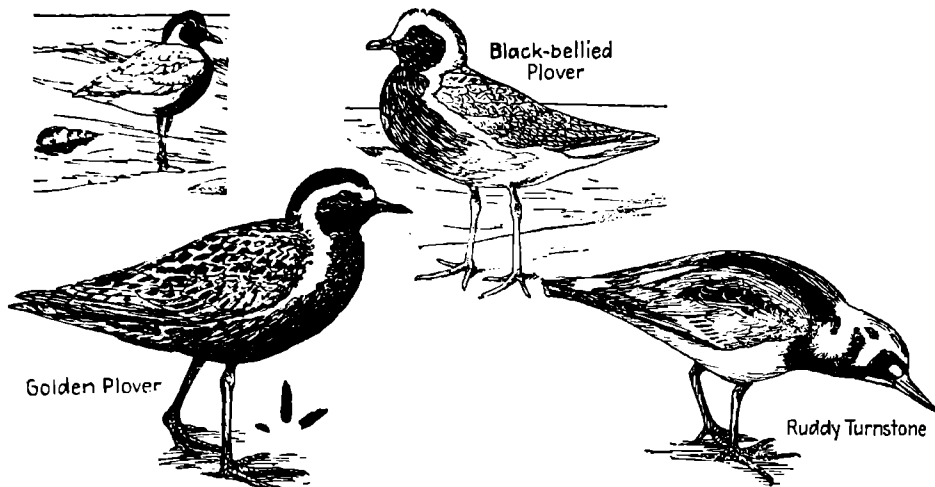
Length $10\frac{1}{2}$ in., wing $6\frac{1}{2}$ in., bill $3\frac{1}{4}$ in. 2 black breast bands instead of 1 common to other ringed plovers; also conspicuous rusty spot at base of tail when in flight. White under parts; white separating black neck rings. Back brown. Sexes alike. Body temperature, 106°F .

Breeds northern British Columbia, northern Ontario, and southern Quebec to southern Lower California, central Mexico, Florida, and Bahamas. Winters southern British Columbia through Colorado, New York, and New Jersey south to northern Venezuela, northern Peru, and Greater Antilles. California Pleistocene.

Nests in open country, on beaches, in plowed fields and meadows. Nest simple. Eggs about 4, buff-white spotted or marked with chocolate chiefly at larger end, $1\frac{1}{2}$ by $1\frac{1}{4}$ in. Incubation 27 days, with both parents showing great excitement if bothered. Young able to run soon after hatching. Sometimes 2 annual broods.

Food largely insects and earthworms or, when about water, crustaceans and other forms of water life. Particularly destructive to mosquitoes, flies, grasshoppers, flea beetles, ticks, army worms, other caterpillars, weevils, and wireworms. Superior flier and its calls often notify other birds of danger. Flight speed, 55 m.p.h.

Flesh inferior. Protected by law and should have continued protection as it is one of most useful of farm birds and does little if any harm. Its ways are always interesting, whether it is flying high, dipping on a shore, sitting on its eggs, trying to lead an enemy from its young, or feeding in a meadow.



PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Charadriidae. PLOVERS, TURNSTONES

Golden Plover, 271

Ploveria dominica

Length to 11 in., including 3-in. tail and 1-in. bill. Wingspread to 23 in. Weight to 9 oz., male and female being about same size. Appears larger than killdeer. Lacks white that shows on wings and tail of black-bellied plover. Golden brown on upper parts. In spring, shows white line over eye and downward on neck.

Breeds from Point Barrow in the Arctic, to Baffin Bay and south to Churchill, Manitoba. Winters on pampas of Brazil, Argentina, Paraguay, Bolivia, and Uruguay, migrating nonstop over Atlantic Ocean from Nova Scotia to South America or going down Mississippi Valley or Pacific Coast. Sometimes found in Greenland, Great Britain, or Australia.

Nest a mere depression in tundra, with leaf lining, not carefully made. Eggs, 4, $2\frac{3}{10}$ by $1\frac{3}{8}$ in.; pear-shaped, slightly smaller than those of black-bellied plover. Incubation for 27 days, by both parents. 1 annual brood. Birds flying across Atlantic are fat when they start but emaciated at end of trip.

Food largely insects such as grasshoppers, crickets, curworms, white grubs, with some berries on occasion. Gives a repeated *coodle* call, and may repeat raising their wings high over back while on ground. Stay together in flocks and so are relatively easily decoyed unless they have been unduly frightened.

Economic importance as destroyers of insects should far outweigh their value as game birds, but it is doubtful if this will be recognized. Since birds are intercontinental, their survival depends on their treatment in South America as well as in North America. Their long sea migration is one of the marvels of bird lore.

Black-bellied Plover, 270

Squatarola squatarola

Length to $13\frac{3}{8}$ in. Wingspread to 25 in. Weight to $10\frac{1}{2}$ oz. Sexes colored alike. Tail and rump always white; black axillary feathers, under wing, constant. Summer, pale gray spotted with black above; forehead, sides of neck, and upper breast, white; throat, sides of head, breast, and belly black but with white under tail. Winter, white or light-breasted, stocky, brownish-gray birds.

Breeds along Arctic coasts of North America, Europe, and Siberia. Winters from Mediterranean to South Africa, India, Australia, southern British Columbia, Louisiana, California, North Carolina, south to Brazil, Peru, and northern Chile. In migrations, covers most of United States. Several races, based largely on range.

Nests in hollow on ground among plants, often lined with grasses and lichens. Eggs late June and early July, 4, $2\frac{3}{8}$ by $1\frac{3}{8}$ in.; pear-shaped, light olive brown with heavy spots on larger end. Incubation by both sexes. 1 annual brood. Young olive brown with black spots above; neck and under parts white, with black eye lines; first winter, like female.

Food, mollusks, worms, crustaceans, spiders, earthworms, and insects gleaned from shores or sometimes from fields. In fall migration, adults precede young, birds flying in masses, lines, V's or small groups. Spring migration extended, lasting in United States from April through June. Related golden plover lacks white under tail of this species.

A high-class shore bird from sportsman's viewpoint because of relative abundance, skill in flying, and edible qualities. May be of some value as a destroyer of harmful insects but this can hardly be great because of nature of the favored habitat. Worthy of protection to assure continued abundance.

Ruddy Turnstone, 283a

Arenaria interpres

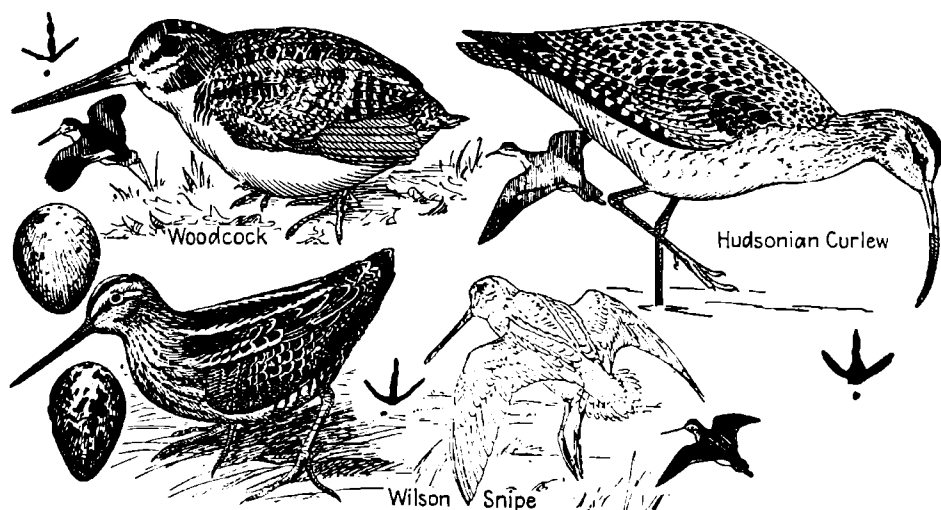
Length about 9 in., including $2\frac{3}{4}$ -in. tail and $\frac{9}{10}$ -in. bill. Wingspread to $19\frac{3}{8}$ in. Weight to 4 oz., with female larger than male. Larger than spotted sandpiper, more compact and low, with orange legs, and in breeding season with red back and conspicuous black on face and breast. Both sexes have similar color pattern, but female is duller.

Breeds from western and northern Alaska to western Baffin Bay. Winters from central California to Texas, Louisiana, Mississippi, and North Carolina, and south to southern Brazil and central Chile. European turnstone is a subspecies, breeding in Arctic Europe and wintering from southern Europe and Asia to south Africa.

Nests usually on coastal islands, in a hollow, on ground, with or without plant shelter. Eggs 3-4, $1\frac{3}{8}$ by $1\frac{3}{8}$ in.; pear-shaped, grayish-green to brown with dark-brown or purplish spots. Nesting period June-July. Incubation by both sexes. 1 brood a year. Downy young blackish-gray above, with white forehead strip, black eye line, and white chin.

Food largely crustaceans and other marine animals such as the horseshoe crab, including eggs of many kinds. It gorges itself and becomes fat in fall. Call a repeated *kuk* or a clear whistled deep repeated *quittock*. Migration routes are along coasts. Rarely seen inland in fresh-water areas.

Since being protected by law, it has begun to regain its numbers that were greatly reduced because of heavy hunting. In fall has a fine flavor and is considered a delicacy but this thrill to the palate cannot match the thrill to the eye supplied by the living bird in its natural environment.



PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Scolopacidae. WOODCOCKS, SNIPE, SANDPIPERS

Woodcock, 228 *Philobela minor*

Length to 1 ft., wingspread to 20 in., bill to 3 in. Weight, cocks to 6 oz.; hens to 8 oz. Wings more blunt than those of Wilson's snipe. More stocky, browner, more nocturnal, and more whistling in flight. Flight of fluttering nature. In flight, hind portion of wings shows darker than fore part.

Breeds from southern Manitoba to southern New Brunswick, and south to Colorado, northern Missouri to New Jersey and south to Texas and Florida. Occasionally in Bermuda, Newfoundland, and Montana.

Cock courts hen by twittering call, high spiral flight, plunge, and strut. Nest on or near wet ground. Eggs 3-4, variable in color, brownish; $1\frac{1}{2}$ by $1\frac{1}{8}$ in. Both sexes incubate, 20-21 days, and care for brood 1 year. Young downy when hatched, dark brown and tan, may be carried by parent.

Food principally earthworms but grubs, beetles, and other insects may be substituted if earthworms are not available. After July molt, young are like adult but may not mature until next year. This, coupled with small brood, tendency to congregate in flocks in migration, and direct flight makes it difficult to survive heavy hunting. Speed, 13 m.p.h.

Considered superior game bird because of high quality of flesh and direct flight. Bag limit of 4 a day too high in face of records showing it is now practically wiped out of upper Mississippi Valley, and numbers generally are smaller than past records indicated would be possible through wise management.

Wilson's Snipe, 230 *Capella gallinago*

Length to $11\frac{3}{4}$ in., wingspread 20 in. Weight to 5 oz. Sexes colored alike. Extremely long bill, streaked plumage, white belly, zigzag irregular flight, cracking cry, pointed wings, short orange tail serve to identify. Lighter colored and slimmer than woodcock; larger than spotted sandpipers.

Breeds from Alaska to New Brunswick and south to southern California and Pennsylvania. Winters from Alaska to Virginia and south to Brazil but occasionally as far north as Nova Scotia. Accidentally found in Hawaii, Great Britain, and Greenland.

Cock courts by remarkable spiraling flight with "winnowing" sound and plunge, commonly at dusk. Nest on ground, of grass, not elaborate. Eggs 3-4, greenish-brown, spotted or blotched, $1\frac{1}{2}$ by $1\frac{1}{10}$ in. Incubation about 20 days. 1 annual brood. Young yellow, darker above, with dark line from eye to bill. Mature in 18 months.

Food largely insects and other small animals but also some plants. Cannot be considered injurious. Can dive and swim well. Courtship sound produced by vibration of outer tail feathers in downward plunge. Flight speed to 70 ft. per sec. Feeds by probing deeply into soft wet soil with long bill.

Recognized as game bird because of remarkable confusing flight serving as a marksman's challenge and because of food value of flesh. Really too small to justify being killed. In 15 years annual take in New York dropped from 9,847 to 510. Fortunately, market hunting is now illegal. Danger of extermination not officially recognized.

Hudsonian Curlew, 266 *Numenius phaeopus*

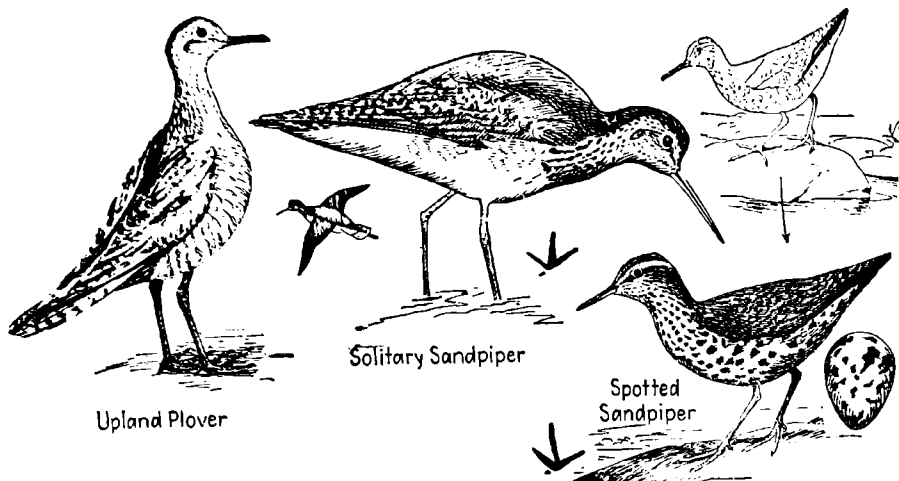
Length to $18\frac{3}{4}$ in., wingspread to 33 in., tail 4 in. Hen larger than cock. Bill curved downward, 4 in. long. Long-billed curlew of West, *Numenius americanus*, is 26 in. long, wingspread 40 in., bill to 9 in.; has bright cinnamon wing linings; less gray than the Hudsonian curlew.

Hudsonian curlew breeds from mouth of Yukon in Alaska to northern Manitoba but nonbreeding individuals may be found in summer along Atlantic Coast from Virginia to Ecuador. Winters from Lower California to Honduras and Chile. Long-billed curlew breeds from Utah to Kansas and Wisconsin; winters from central California to Florida and Guatemala.

Nest a depression or in a grass tussock. Eggs of Hudsonian curlew 4, pear-shaped, olive green, obscurely spotted, $2\frac{1}{2}$ by $1\frac{1}{3}$ in. Incubation by both sexes, for 25 days and 1 annual brood. Eggs of long-billed curlew, $2\frac{9}{10}$ by 2 in. Incubation probably about 30 days. Young of both able to run about soon after hatching.

Food, fiddler crabs, spiders, grasshoppers, beetles, crustaceans, either caught on surface or probed for with long bill which can be thrust into earth. Frequents tide flats and flies offshore in formations like geese, long bill being usually easily seen and serving as identification. Speed, 36 m.p.h.

Hudsonian curlew is not good food compared to other curlews. Because of its habitat, it is not so useful in checking pests of agricultural lands. Long-billed curlew gets greatly excited when its nest is approached and by its calls and behavior gives away its greatest secret. Too useful to be destroyed.



PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Scolopacidae. WOODCOCKS, SNIPE, SANDPIPERS

Upland Plover, 261 *Bartramia longicauda*

Length to 12 $\frac{2}{3}$ in., including 3 $\frac{1}{2}$ -in. tail and 1 $\frac{1}{2}$ -in. bill. Wingspread to 25 in. Weight to 7 oz.; sexes equal. Rather uniformly brown-streaked, with long neck, small head, but relatively short curlew-like bill, and habits of perching on posts like willets, and upon alighting of raising wings in air.

Breeds from northwestern Alaska in northern Yukon area to southern Mackenzie, southern Quebec and Ontario, and south to Oregon, Virginia, and Oklahoma. Winters on South American pampas from southern Brazil to Argentina and Chile. Accidentally found in Greenland and western Europe. Should be considered as essentially a rare bird of fields and pastures.

Nests in grassy meadows, grainfields, or pastures. Nest on ground, well-hidden in vegetation. Eggs 4, 1 $\frac{1}{4}$ by 1 $\frac{3}{8}$ in.; short, bluntly pear-shaped, larger than those of similar woodcock; cream to olive to buff with few large gray spots or blotches. Incubation probably 17 days by both parents. 1 annual brood.

Food largely insects such as weevils, fever ticks, curworms, white grubs, cotton worms, locusts, grasshoppers, crayfish, and similar essential enemies of farm crops. It may also eat small amounts of grain and seeds of plants. Call a sweet, melodious *kíp-ip-ip* or *quit-it-it* followed by a descending whistle.

Essentially useful as a destroyer of enemies of farm crops and formerly considered a game bird, but now so rare that it is worthy of all possible protection. Many birds get killed by mowing machines since they nest in pasture grasses. They receive no protection whatever in South America.

Solitary Sandpiper, 256 *Tringa solitaria*

Length to 9 in., wingspread to 17 in., tail to 1 $\frac{1}{4}$ in., bill to 1 $\frac{1}{4}$ in. Weight to 28 oz. Lacks white stripe shown on wing of spotted sandpiper. Shows tail with conspicuous white sides and faint dark crossbars. Wings appear dark and show a deeper stroke than in spotted sandpiper. Teeters head instead of tail.

2 subspecies, Eastern and Western. Summers from Alaska to Newfoundland, south to northwest border of United States, Iowa, and Pennsylvania. Winters from Texas and Florida south possibly to Argentina. Appears as migrant between summer and winter ranges and known to breed in Alaska.

Uses abandoned nest of some other bird such as a grackle, robin, or jay. Eggs 4-5, greenish to reddish-brown with browner spots usually nearer larger end, the spots forming blotches; 1 $\frac{3}{8}$ by 1 in. 1 annual brood. Young birds gray-brown above and lighter beneath.

Food chiefly insects: grasshoppers, water boatmen, caterpillars, dragonfly nymphs; also spiders, worms, crustaceans, and small frogs. Some insects may be caught on the wing by sudden turns in flight. It flies higher than spotted sandpiper, more swiftly, and in a more zigzag manner. Usually tame and unsuspicious.

Useful as destroyer of insects. Too small to have value as game and too dull to interest good sportsmen. Fortunately, it is illegal to shoot them at all in United States.

Spotted Sandpiper, 263 *Actitis macularia*

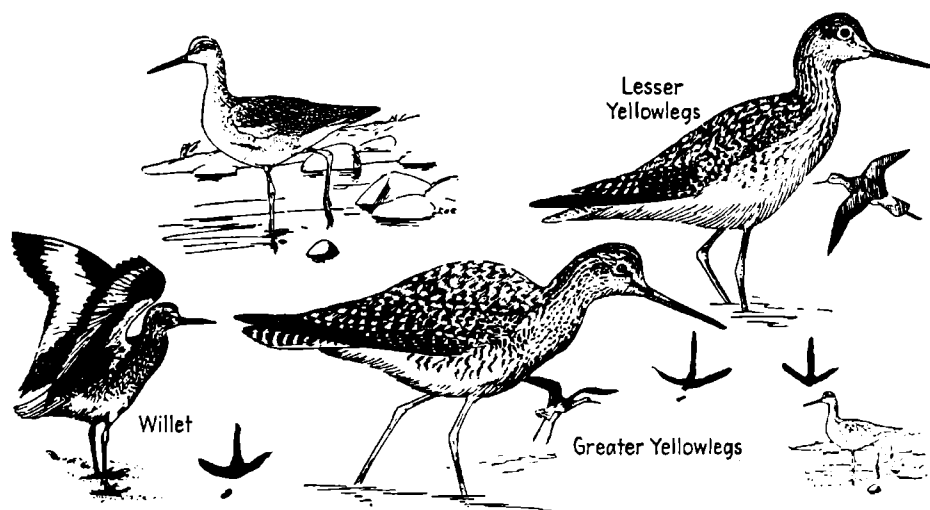
Length to 8 in., wingspread to 14 in., tail 2 $\frac{3}{4}$ in. Weight 2 oz. Hen larger than cock. Breast definitely spotted with large round spots, not streaks, except that young birds and fall adults do not show this character. Outer tail feathers white with black bars. Wing stroke short. Has teetering habit.

Breeds from tree limit in northwest Alaska to northern Ungava Peninsula and Newfoundland, south to southern California, Louisiana, and South Carolina. Winters from southern British Columbia, Louisiana, and South Carolina to southern Brazil, central Peru, Bolivia, and Argentine. Also in Greenland and western Europe.

Nests in single pairs on ground. Nest grass-lined or not, in a variety of places. Eggs 3-5, pear-shaped, clay to cream, spotted and blotched with chocolate, 1 by 1 $\frac{3}{8}$ in. Incubation 15 days, by both sexes. 1 annual brood. Young run soon after hatching.

Food small animal matter, chiefly insects, including army worms, grasshoppers, caterpillars, cutworms, cabbage worms, beetles, and grubs. Does not flock much even in migration except in South in winter. Can dive from full flight, swim, and run under water with help of wings.

Entirely useful. Protected by law and worthy of even more protection through southern part of its range. Call an oft-repeated *peet, peet*, or *peet, weet*. An inconspicuous double white wing stripe shows in flight.



PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Scolopacidae. WOODCOCKS, SNIPES, SANDPIPERS

Willet, 258

Catoptrophorus semipalmatus

Eastern willet: length 16 in., wingspread 29 in., tail $3\frac{1}{2}$ in., bill $2\frac{1}{8}$ in. Weight to 10 oz. Wings in flight conspicuously black and white. Tends to raise wings upon alighting, showing patches. Legs bluish. Western willet reputedly paler on back, with longer bill, and slightly larger.

2 subspecies breed from east central Oregon to Nova Scotia, south to southern California, Ecuador, and Florida. Winter from northern California to North Carolina and in Brazil, Peru, and Ecuador. Accidentally in Europe, British Columbia, and south-eastern Alaska. Western willet said to be fall Atlantic Coast migrant.

Courtship by pursuit and holding wings erect. Nest among grasses of sandy or dry spots near water on or in pasture swales or in open. Eggs 4, olive, buff, or greenish, $2\frac{1}{2}$ by $1\frac{1}{2}$ in. Incubation apparently unknown, but young run soon after hatching, though they possibly may be carried by parents between thighs.

Food, aquatic insects, small mollusks, fish fry, fiddler crabs, and some seeds, tender plant parts, roots, and on occasion cultivated rice. Strong flier which may hover over a given point, ordinarily shy, but at breeding season seems bold in attempt to lead intruders away from nest. Speed, 27 m.p.h.

Flesh of a rank flavor and so not ordinarily considered edible. Certainly, it cannot be considered a delicacy and so should be left unharmed, at least until its numbers can be more restored than is now the case. The Eastern willet is rare over much of its original range.

Greater Yellowlegs, 254

Totanus melanoleucus

Length to 15 in. Wingspread to 26 in. Weight to 10 oz., with average 6-8 oz. Female larger than male. Slim, gray and white, with bright yellow legs. Shows whitish rump and tail and darker wings in flight. Sexes colored similarly. Bill slightly up-curved. Call a clear, penetrating, yodeling whistle of 3-5 notes.

Breeds from Alaska to central Alberta, southern Ungava, and Labrador to southern British Columbia and Newfoundland. Winters in Washington, California, Arizona, and South Carolina to Patagonia, with birds accidentally in British Isles, Greenland, and Bermuda. Modern form is known as a fossil from California Pleistocene. Essentially a bird of shores and marshlands.

Nests usually in a clearing or burn of a forested area near a lake or large stream. Nest on ground, in a depression, May-June. Eggs 4, $1\frac{1}{10}$ by $1\frac{1}{2}$ in.; pear-shaped, gray-white splashed with brown and lilac. Incubation by both sexes. Probably, 1 annual brood. Chicks long-legged and active soon after hatching.

Flying bird holds long legs out behind and long neck and bill forward; sails before alighting and teeters after. Food, captured by wading about among water plants in shallows, consists essentially of mollusks, crustaceans, and aquatic insects, with now and then a small fish. By fall, birds are plump and fat.

Has suffered severely from hunting. Since the birds come readily to crude imitations of their calls and fly in such a way that they are easily shot, it is surprising that they were able to maintain an existence. They are now protected by law. Evidence of their decrease is found in a take of 5,588 in New York in 1921 and a take of 154 in 1927.

Lesser Yellowlegs

Lesser Yellowlegs, 255

Totanus flavipes

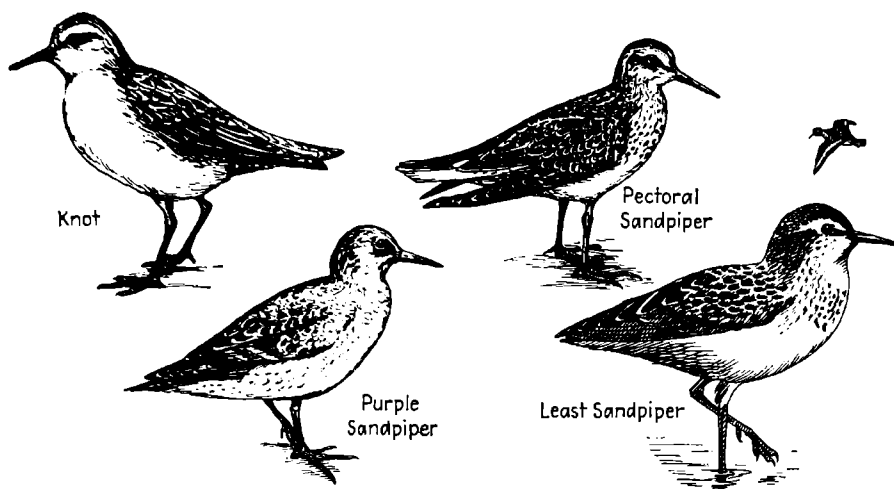
Length to 11 in. Wingspread to $21\frac{1}{2}$ in. Weight to $3\frac{1}{2}$ oz. Female larger than male. Slim gray and white bird with bright yellow legs. Smaller than greater yellowlegs, but otherwise much like it. Fine marbling on inner surface of flight feathers of greater yellowlegs is less conspicuous in lesser yellowlegs.

Breeds from Yukon Valley in Alaska to Ungava and northern Quebec, south to British Columbia and southern Manitoba; formerly to just south of Great Lakes. Winters in Mexico, Louisiana, Florida, and the Bahamas and south to Argentina, Chile, and Patagonia, with greater concentration in southern part of area. Haunts shores of larger bodies of water.

Nests not far from water on dry open ground, among scattered spruces; a hollow, with small lining of leaves and grasses. Eggs 4, $1\frac{1}{2}$ by $1\frac{1}{10}$ in.; pear-shaped, dark grayish or light, with blotches of chocolate or brown and ash gray. Nests in June. Incubation mostly by female. 1 annual brood.

Like to remain in flocks wading about together in shallow waters of bars and shore lines. Usual call of 2 whistled notes, less vigorous than strong call of greater yellowlegs. Not shy and often may be studied close at hand while they eat or wander about. Food essentially of smaller invertebrate animals, including many insects.

Formerly considered a game species but is now fortunately protected by law. New York State take dropped from 4,145 in 1921 to 98 in 1927 before protective law was put into effect. Birds of a flock may return to see what happened to those that may have been shot, hovering about and offering easy targets.



PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Scolopacidae. WOODCOCKS, SNIFE, SANDPIPERS

Purple Sandpiper, 235
Erolia maritima

Length to 9½ in., including 2¾-in. tail and 1½-in. bill. Wingspread to 16 in. Weight about 3 oz., with sexes in general equal, though bill of female is usually slightly longer than that of male. A dark sandpiper, robust, with white belly, short yellow legs, and yellow or orange base to bill. Conspicuous white on dark wing in flight.

Breeds probably from Melville Island, Ellesmere Island, and northern Greenland, to southern Greenland, southern Baffin Bay and islands in Hudson Bay; also in Spitsbergen, Iceland, Norway, Russia, and Siberia. Winters in America from southern Greenland south to New Jersey, and in Europe to the Baltic States, British Isles, and Mediterranean. A winter seashore bird in New England.

Nests on ground, either among mosses or on bare ground. Nest a mere depression, lined with grass or leaves. Eggs 3-4, 1½ by 1¼ in.; pear-shaped, greenish, clay, or drab with conspicuous brown markings of various shades. Nesting period May-June. Incubation probably about 20 days by both sexes but chiefly by male. 1 annual brood.

Food, snails and other small shelled animals, gleaned mainly from among drifts of seaweed and the like. Also feeds on animals gleaned from wave-washed rocks. Birds can swim and usually appear in flocks. In New England appear in September, are most abundant in November, and have vanished by mid-March.

Protected by law, but even when it was legal to shoot them they were not considered legitimate prey, largely because of the strong fishy flavor of their flesh. Why anyone should wish to kill so small a bird as this is hard to understand. Probably neutral in its general economic importance.

Pectoral Sandpiper, 239
Erolia melanotos

Length to 9¾ in., including 2¾-in. tail and 1½-in. bill. Wingspread to 18 in. Weight to 4 oz., male being larger than female. Larger than spotted sandpiper; shows a contrasting white belly, streaked brown breast, and 4 outer tail feathers shorter and lighter than those in middle. Twice the size of least sandpiper.

Breeds in Arctic, from northeastern Siberia to northern Alaska near mouth of Yukon and northeastern Mackenzie and Southampton Island. Winters in South America from Peru and Bolivia to northern Chile, Argentina, and Patagonia, rarely migrating down Pacific Coast but common particularly in fall migration through Mississippi Valley and along Atlantic.

Nests on dry ground near pools; a mere depression, but usually grass-lined. Eggs 3-4, 1½ by 1¼ in.; pointed pear-shaped, pale green, brown, or olive blotched with black or purplish-gray. Nesting period June-July. Male develops throat structure making it possible for him to give a booming note during courtship period.

Food mostly insects such as grasshoppers, weevils, beetles, cutworms, horseflies, mosquitoes, and snails and small shellfish as well as some vegetable matter. Flocks seem to be most common near salt marshes. Birds seem to sit tight when approached, more than do many other shore birds. Migration is in small flocks.

Useful destroyer of injurious insects. Formerly considered a valuable game bird because of the nature of flesh but now protected by law at all times. Call has been described as a repeated *kreek*. Birds are seen in northeastern United States in greatest numbers in August and September.

Least Sandpiper, 242
Erolia minutilla

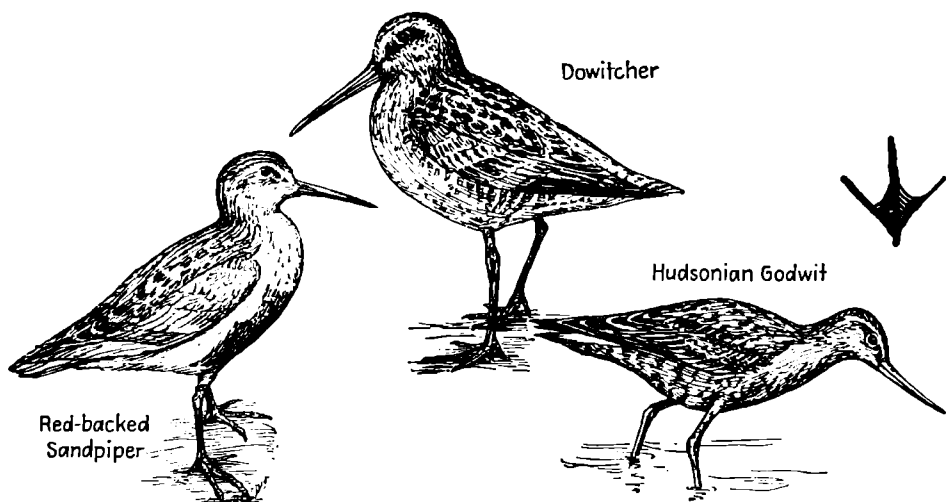
Length to 6¾ in., wingspread to 12¼ in., tail 2 in., bill ½ in. Hen larger than cock. Smallest of sandpipers, with yellow or greenish-black legs; generally browner than semipalmated sandpiper. Generally streaked brown above and white beneath with breast and throat brown-streaked in spring. Lacks partially webbed feet of semipalmated sandpiper.

Breeds from northwestern Alaska to Labrador and south to Yukon Valley, Newfoundland, and Nova Scotia. Winters from southern California to Texas and North Carolina and south through West Indies, Central America, Brazil, and central Patagonia. Accidentally in Europe, Greenland, and Siberia.

Nests about wet flats or grassy lowlands. Nest lined with some grass and possibly leaves. Eggs 4, pear-shaped, drab or pale brown with rich brown markings, 1¼ by ¾ in. Incubation largely by cock. 1 brood a year. Young downy and buff in color when hatched, with pure white chin and throat, darker on upper parts.

Food, myriads of small forms of animals found along shore lines, gathered by dashing in and out with waves, picking up things as they lie exposed and before another wave can come in. Action in flocks made of families or groups of families is worth watching at any time.

Too small to be of any food value to man and is protected by law. Serves as gleaner of waterway margins and undoubtedly as food for many enemies. May well destroy larvae of disease-bearing insects which may be found in its habitat. Called "mud peep" because it prefers grassy mud flats.



PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Scolopacidae. WOODCOCKS, SNIPE, SANDPIPERS

Red-backed Sandpiper, 243a *Erolia alpina*

Length to 9¼ in., including 2½-in. tail and 1¾-in. bill. Wingspread to 15¾ in. Weight to 3 oz., female being larger than male. In spring, rusty red above with white breast and black belly. In winter plain gray above and grayish across breast. Bill long, stout, and downward-curving at tip.

Breeds on northern Siberian coast and in Arctic America from mouth of Yukon to Churchill on Hudson Bay. Winters from southern British Columbia to New Jersey, and south to southern Lower California, Texas, and Florida. Also found in Asia from China and Japan to Malay Archipelago.

Nests near water, on ground, usually on a dry grassy knoll surrounded by water; a mere depression, with or without plant lining. Eggs 4, 1½ by 1¼ in.; pear-shaped, buff, gray, or olive marked, blotched, stained, or spotted with chocolate or gray. Nesting period June. Incubation by both sexes. 1 annual brood.

Food probably largely crustaceans and water insects including oyster worms. Red-backed sandpipers appear just before geese in fall and after most other shore birds have gone. They feed in mixed flocks with stragglers of other species, run rapidly, fly nervously, and wade up to their bellies.

Protected by law, and useful to some extent as destroyers of enemies of some of our important shellfish. May also help somewhat in destroying a few agricultural pests, though this is probably never important.

Dowitcher, 231 *Limnodromus griseus*

Length to 12½ in., including 2½-in. tail and 2½-in. bill. Wingspread to 20 in. Weight to 5 oz., female being larger than male. Related long-billed dowitcher has 3½-in. bill, the 2 probably being races, not species. Generally olive-brown but lighter beneath, with white on rump, tail, and lower back, unlike similar Wilson's snipe. Breast in spring cinnamon.

Long-billed dowitcher breeds from mouth of Yukon to western Mackenzie and south to British Columbia. Eastern dowitcher breeds from central Alberta and to Churchill on Hudson Bay. Long-billed dowitcher winters from Louisiana to California and south to Ecuador. Eastern dowitcher winters from Florida and West Indies to Brazil and Peru. In migration, Eastern outnumbered Long-billed on West Coast.

Nest of long-billed dowitcher on bare or marshy ground, in moss or depression, unlined. Eggs 4, 1½ by 1½ in.; pear-shaped, clay or gray with greenish cast, and large distinct brownish spots well-crowded at larger end but scattered over surface. Nesting period June. Nest of eastern dowitcher, a grassy knoll surrounded by water.

Food essentially small animals gleaned from habitat, including oyster worms, small mollusks, horseflies, grasshoppers, leeches, water beetles, and the like. Both races feed in moist grassy areas. Both swim well, nodding head while doing so, but prefer salt-water areas more than does Wilson snipe. Call of eastern dowitcher, a repeated *tu*; long-billed dowitcher, a single *keek*.

These are game birds to those who would kill a beautiful and interesting feathered 5 oz. of flesh in spite of the legal protection it has. They may be useful gleaners of grassy marshes and may help agriculture to some extent but are probably essentially neutral.

Hudsonian Godwit, 251 *Limosa haemastica*

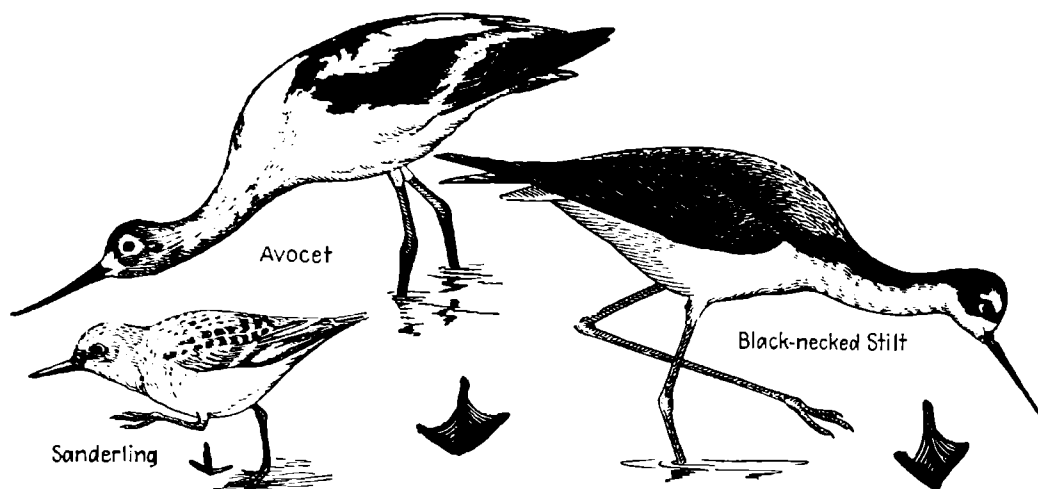
Length to 16¾ in., including 3½-in. tail and 3½-in. bill. Wingspread to 28 in. Weight to 13 oz., female being smaller than male. Bill slightly curved upward. Tail with narrow white band at end, with adjacent broader black band and base of tail white. Wings dark underneath, black near body, and narrow marginal white to rear.

Breeds from lower Anderson River in Mackenzie to Port Clarence, Alaska, and east to Hudson Bay at Churchill and Southampton Island. Winters in Chile, Patagonia, and Falkland Islands, migrating mostly east of Great Plains, going down Atlantic Coast in autumn and up Mississippi Valley in spring. Marbled godwit of western United States and Canada is a larger, browner species.

Nests in or near water in barren grounds. Nest a leaf-lined hollow. Eggs 2-4, 2½ by 2¼ in.; pear-shaped, dark-green or olive, obscurely blotched with brown. Nesting dates June. Incubation probably about 24 days, with both sexes taking part. 1 annual brood.

Food, insects, particularly of waterways, worms, crustaceans, and mollusks; in fact, almost any small animals to be found in bird's environment. Call a relatively low *chip* for such a large bird; when frightened, a sandpiper-like chittering. In northern migration, probably flies across Gulf of Mexico in single flight.

Was considered game bird but is deserving of every protection. Since it receives no protection in Southern Hemisphere, it needs all it can get in Northern, particularly as it is here that it breeds. Eventually, if it does not become extinct, intercontinental protection for such birds may be effected. In flight, is characterized by dark under wings.



PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes

Family Scolopacidae

Sanderling, 248

Crocebia alba

Length to $8\frac{2}{3}$ in., including $1\frac{1}{2}$ -in. tail and $1\frac{1}{2}$ -in. bill. Wingspread to $16\frac{3}{4}$ in. Weight to 3 oz., female being larger than male. Common name "whitey" helps identify it as whitish plump sandpiper. Shows conspicuous flashing white stripe on wings. Appears light in fall; rusty in spring. Legs and beak black.

Breeds from Arctic islands, Southampton to northern Greenland, and in Iceland, Spitsbergen, and northern Siberia. Winters from central California to Virginia, south to Patagonia and from the Mediterranean, Burma, and Japan to South Africa and many Pacific islands. Found almost wholly at edge of breakers on sand beaches but less commonly along inland-waterway beaches.

Nests near water but sometimes several hundred feet above sea. Nest a grass- or leaf-lined hollow. Eggs 4, $1\frac{1}{2}$ by 1 in.; pear-shaped, pale brown with fine dark spots at larger end. Incubation for 25 days by both sexes. Nesting period June-July. Young downy, with central black line from bill through forehead to top of head, nape buff, and elsewhere dark buff.

Food largely mollusks, worms, crustaceans, and insects of the beaches, but may eat insects inland and may even eat seeds and small amounts of vegetation, such as moss and algae. In migration, sanderlings go along both coasts and a short way into interior of continent. Call a short distinct *kipp*.

Birds are too small to be considered as game, and too interesting to be killed by anyone with the slightest touch of kindness. They are always intriguing to leisurely "beachcombers" who marvel at their skill in avoiding being overwhelmed by incoming breakers.

Avocet, 225

Recurvirostra americana

Length to 20 in., wingspread to 38 in., tail $4\frac{1}{2}$ in., bill to 4 in., curved upward; bare legs, to $6\frac{1}{2}$ in. Black and white, with a rusty head and neck, unlike any other bird with which it might be confused. Female smaller than male.

Breeds from eastern Washington to southern Manitoba, and south to southern California and Iowa, formerly to New Jersey. Winters from central California and southern Texas to Guatemala, with occasional birds in Ontario, British Columbia, New Brunswick, and Florida. Rare east of Mississippi River.

Nests on ground near shallow water, or even surrounded by shallow water among plants, with or without any structure. Eggs 3-4, variable in shape and color, olive to light brown with many small brown spots, $2\frac{1}{10}$ by $1\frac{1}{2}$ in. Incubation 24-25 days. Probably only 1 brood each year. Young in juvenile plumage resemble adults.

Food, grasshoppers and other insects, fish, mollusks, and crustaceans and a variety of other small animal forms available to it in its environment. Performance of avocets about their nests at breeding time is worth going miles to see and their reflection in still water has great beauty to the artist, amateur or otherwise.

Perfectly harmless and essentially useful bird. Ordinarily, habit of eating fish and some other aquatic animals makes flesh unpalatable even when it is cooked. It is worthy of every protection at all times.

Black-necked Stilt, 226

Himantopus mexicanus

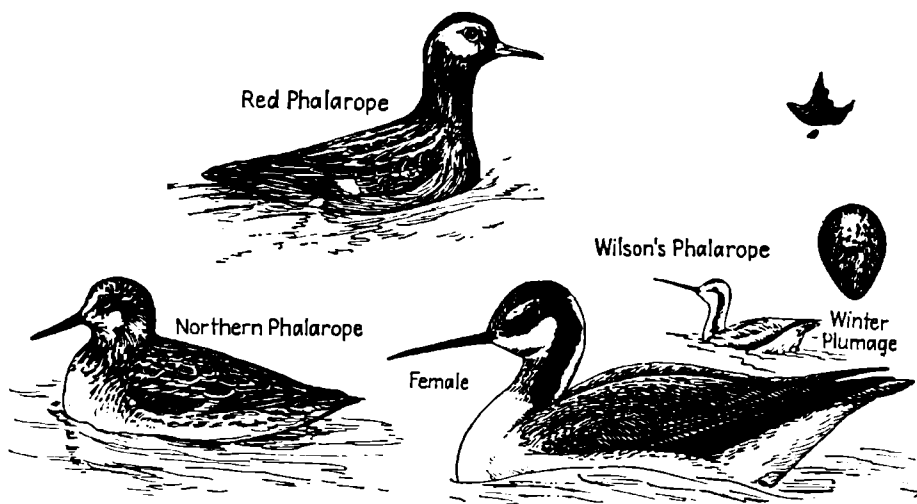
Length $15\frac{1}{2}$ in., wingspread 30 in., tail $3\frac{3}{4}$ in., bill $2\frac{3}{4}$ in., bare portion of legs 8 in. Female longer than male but with shorter legs. Black above, white beneath. Sometimes shows white beneath, long dangling red legs, and black uniform wings. Young birds duller than adults.

Breeds from central Oregon, Utah, Colorado, Nebraska, and central Florida south through northern Lower California, Mexico, West Indies, Brazil, and Peru. Winters from Lower California to Florida, south through Brazil and Peru. In migration, occasionally found in North Dakota, Illinois, New Brunswick, and Bermuda.

Nests in small colonies or singly, on ground near or in water, among weeds. Eggs 3-4, pear-shaped, clay-colored, greenish, slightly glossy and marked with brown, black, or gray, $1\frac{1}{8}$ by $1\frac{1}{8}$ in. Incubation less than 21 days, by both sexes. Young able to run about almost as soon as hatched. Adult at 2 years.

Food, grasshoppers, weevils, and other destructive insects as well as hosts of small animals to be found in habitat of marsh and water plants where bird lives. Bird is suspicious but noisy when nest is approached; then dances a crazy dance, waves wings, and drags leg as though broken, and generally creates a disturbance.

Does no possible harm to agricultural interests and, if living near farm lands, must do considerable good, so there is no reason why it should not be entitled to complete and adequate protection throughout its range.



PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Phalaropidae. THE PHALAROPES

Northern Phalarope, 223
Lobipes lobatus

Length to 8 in., including $2\frac{3}{4}$ -in. tail and 1-in. bill. Wingspread to $14\frac{1}{2}$ in. Weight under 2 oz., with female larger than male. Conspicuously gray, white below with tan stripes down back and tan fleckings on neck. Breeding female has conspicuous chestnut patch on sides and front of white throat. Male less conspicuous, and both grayer in winter, without chestnut.

Breeds from Pribilof Islands and northern Alaska to Greenland and south to northern Manitoba and northern Quebec and in Iceland, Norway, Russia, and Siberia. Winters off coasts of Peru and West Africa. Migrates off both coasts of America and through interior of Canada and United States to Patagonia. Alights and rests safely on sea.

Nests on ground, among grasses or under grass cover, a depression, commonly grass-lined but not always. Eggs 3-4, pear-shaped, greenish to olive to gray with blackish or chocolate blotches, $1\frac{1}{2}$ by $1\frac{1}{4}$ in. Incubation 14-18 days, by male only. 1 annual brood. Downy young tan with dark-brown saddle; lack a dark line at base of bill found in red phalarope.

Food, minute animals of sea or land, including numerous crustaceans, insects, mollusks, and their kin. They flutter restlessly from one place on surface of the sea to another and do not seem greatly frightened by approaching ships. Most abundant in New England in May, August, and September when they appear with flocks of red phalaropes.

Of little if any economic importance. Sailors use them as a sign of land as indicated under the similar red phalarope, but during the migratory season this may be misleading.

Red Phalarope, 222
Phalaropus fulicarius

Length to 9 in., including $2\frac{3}{4}$ -in. tail and 1-in. bill. Wingspread to 16 in. Weight just under 2 oz., with female larger than male. In winter grayish and white. Breeding female brighter in color than male but both are reddish beneath, with white or light-colored cheeks. Breeding female gray on top of head and under chin.

Breeds from northern Alaska, northern Ellesmere Island, and Greenland south to Yukon and Southampton Island; also from Iceland to Spitsbergen to eastern Siberia. Winters on ocean off coasts of South America and western Africa. Occasionally found in East from New Brunswick to Florida. Essentially a sea bird migrating well offshore but occasionally found inland.

Conspicuous because female is more showy than male. Nests in grasses or marshy areas usually not far from water; a slight depression, usually grass-lined and usually overgrown with plants. Eggs 3-6, $1\frac{1}{2}$ by $\frac{9}{10}$ in.; long and pear-shaped, buff to clay with large usually chocolate blotches. Nesting period June. Incubation 14 days, by male only. 1 annual brood.

Food, insects, small crustaceans, jellyfish, leeches, small fish, and some vegetable matter such as weed seeds and seaweeds. Floats easily and lightly on seas and rises readily from surface. Has a wider bill and more yellowish legs than its associate northern phalarope. In winter plumage, it also shows more gray on sides of breast.

Of little direct economic importance. Sailors say that from June to July and in December and January a group of 3 or more indicate that land is probably within 75 miles; in the remaining months, any number may be seen migrating much farther from shore.

Wilson's Phalarope, 224
Steganopus tricolor

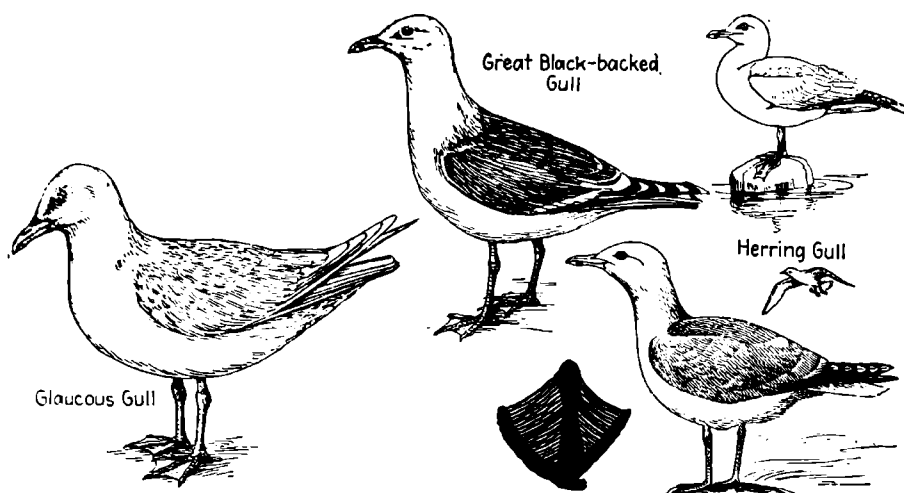
Length to 10 in., wingspread to 16 in., tail to $2\frac{3}{4}$ in., bill to $1\frac{1}{2}$ in. Female larger than male. This "swimming sandpiper" like other phalaropes has front toes lobed and hind toe elevated. In breeding season, a broad cinnamon stripe on neck which changes to black. In flight, shows a white rump and is dark-winged, with no wing stripe.

Breeds from southern British Columbia to northwest Indiana, south to central California, Utah, and Colorado. Winters from central Chile and Patagonia, south to Falkland Islands. After breeding season, most phalaropes go to sea. There are only 2 other species of phalaropes in the world, the Red and the Northern.

Female is more brilliant at breeding time, and does courting. Male makes nest, incubates eggs, and performs many acts ordinarily done by female. Nest a collection of vegetation on ground. Eggs 3-4, long and pear-shaped, light buff, clay, or drab splashed with brown, $1\frac{1}{2}$ by $\frac{9}{10}$ in. 1 yearly brood.

Food, insects such as mosquitoes, leaf beetles, and pill bugs, these being more terrestrial than food of other phalaropes. Birds are active, particularly at breeding time, when a female may court and apparently win more than 1 mate, she of course supplying the eggs for 2 nests.

Probably of some value in destroying insects. Too small to be considered as game and too interesting to be destroyed or to permit their being exterminated further in their natural range. A newly hatched phalarope seems like a good-sized bumblebee. It can disappear in sedges remarkably easily.



PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Laridae. GULLS, TERNS

Glaucous Gull, 42
Larus hyperboreus

Length to 32 in., including $8\frac{1}{2}$ -in. tail and 3-in. bill. Wingspread to $5\frac{1}{2}$ ft., with female smaller than male. Chalky white, without dark wing tips, with large strong bill. Sexes colored alike. First winter, cream or pale buff, with wing tips lighter. Second-year birds almost white throughout. Adults with white somewhat overcast with gray on back.

Breeds in Arctic from northwest Alaska to Ellesmere Island and northern Greenland, south to Pribilof Islands, Hudson Bay, and Newfoundland. Winters from Aleutians to Greenland, south to California, Texas, and North Carolina, occasionally in Hawaii, Europe, Asia, Japan, and other parts of Northern Hemisphere.

Nests singly in small colonies, on cliffs or low islands. Nest a mere depression, or a good-sized mound of vegetation or drift. Eggs 2-4, $3\frac{1}{4}$ by $2\frac{1}{4}$ in.; variable in color, olive, brown, buff, drab, clay, or pale blue-green, spotted or blotched. Incubation 28 days. 1 brood a year. Downy young grayish-white above, white below, with smoky gray on back.

Food, dead fish, carrion, manure, shell-fish, and almost any waste organic material. Powerful, and inclined to take food from other birds or even kill smaller birds for food. Found along New England coast from November to April, usually at sea but rarely resting on water although it does alight on beaches.

One of most destructive of gulls, undoubtedly breaking up some nests of eider ducks but also doing valiant service as a waste destroyer. Like other gulls, not commonly found more than 50 miles from shore. One of most beautiful as well as one of largest of gulls and must be admired for its flying ability.

Great Black-backed Gull, 47
Larus marinus

Length to 31 in., including $2\frac{1}{4}$ -in. bill. Wingspread to $5\frac{1}{2}$ ft. Back is dark slate rather than black, though wing tips are black. Neck, belly, tail, sides, and head of adult, pure white. Legs and feet yellowish or flesh-colored. Eye and beak yellow, but lower bill red spot near tip. Young birds with brown-flecked upper parts.

Breeds from northern Labrador to central Greenland, Iceland, and south through Nova Scotia, British Isles, Scandinavia, and Russia. Winters from southern Greenland, through Black Sea and Caspian Sea area and south to Great Lakes, Delaware, and Mediterranean, sometimes as far as Florida. Has been found in Nebraska.

Nests in pairs or colonies, on coasts of lakes or sea. Nest a mere depression or accumulation of waste vegetable material. Eggs 2-5, $3\frac{3}{8}$ by $2\frac{1}{4}$ in.; olive, buff or drab splotted with brown, white, black, or gray. Incubation 28 days, by both sexes. 1 annual brood. Downy young pale gray, white on breast; upper parts, deep gray.

Food: a scavenger but also destroyer of eggs, young, and even adults of other birds the size of ducks and coots. May destroy insects and rodents as well as birds but does eliminate many wastes and will steal from other less powerful birds. A noisy bird, repeating *cah* often.

Difficult to evaluate this bird wholly. To those who have visited a nesting colony and watched great numbers of them in flight, it has a place in nature which should not be left unfilled, but sportsmen who are themselves interested in killing ducks may not feel so kindly disposed toward it.

Herring Gull, 51a
Larus argentatus

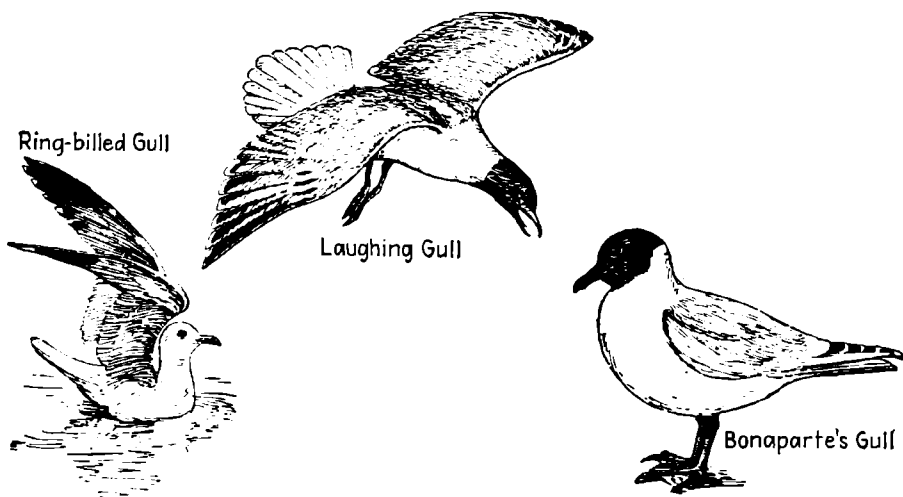
Length to 26 in., wingspread to 58 in., tail to $7\frac{1}{2}$ in., bill to $2\frac{1}{2}$ in. Female slightly smaller than male. Gray back, white head, tail, and under parts, with black wing tips and flesh-colored legs. Young bird dusky brown first year; mottled, the second. Tail entirely dark first year, bare white the second. Larger and without ring bill of ring-billed gull.

Breeds from south central Alaska to southern Baffin Bay, south to northern British Columbia, northern New York, and Massachusetts. Winters from southern Alaska to Gulf of St. Lawrence and south to Lower California, Mexico, Cuba, and Yucatan. Known from Oregon Pleistocene.

Nests on ground or rarely in trees, with little nesting material. Eggs 3-5, variable, light blue, green, drab, brown, or cinnamon, spotted or blotched, $2\frac{9}{10}$ by $2\frac{1}{2}$ in. Incubated by both sexes, 24-28 days. Young birds able to walk about soon after hatching. 1 annual brood.

Food, variety of materials picked from surface of sea or waterway or gleaned from farm lands or garbage heaps. Related species assisted Mormons in surviving a plague of locusts by settling in great flocks and cleaning up pests; for this Mormons erected a monument in Salt Lake City. Flight speed, 36 m.p.h.

Scavengers and enemies of injurious insects but also enemies of ducks and other birds nesting in same territory, where eggs and young provide a ready and delicious feast. Birds are rarely abundant enough to be considered seriously injurious. California gull is State bird of Utah.



Ring-billed Gull

Laughing Gull

Bonaparte's Gull

PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Laridae. GULLS, TERNS

Ring-billed Gull, 54

Larus delawarensis

Length to 20 in., including 6-in. tail and 1½-in. bill. Wingspread to 50 in. Wing tips black with conspicuous white spots. Back and shoulders pale bluish-gray; head and under parts almost pure white. Black ring around bill. Legs and feet yellow-green. First year, brown-flecked on white, with darker wing tips and dark tail. Second year, like adults but with black-tipped tail.

Breeds from southern Alaska to north shore of Gulf of St. Lawrence, south to southern Oregon, southern Colorado, and northern New York. Winters from British Columbia to Maine and south to central California, southern Mexico, Gulf Coast, and Cuba. Also found in Bermuda and Hawaii. Essentially a bird of inland waterways.

Nests in colonies, sometimes with other water birds, usually on ground but sometimes in low tree. Eggs 3, 2½ by 1½ in., in general like small herring gull eggs. Incubation 21 days. 1 brood a year. Nesting period May–August. Young, with down, of 2 color phases: some smoky gray and others buff with darker spots.

Food: essentially a scavenger, eating dead fish, rodents, small aquatic animals, and sometimes contents of nests of other birds. Known to eat many grasshoppers. Haunts garbage dumps and follows ships, seeking refuse that may be dumped overboard. Call a protesting, repeated *kree, kree*. When in flock, gives more subdued *kow, kow*.

This was once the common gull of America, but it no longer is. It is undoubtedly most valuable as a destroyer of garbage and as a general scavenger. Beautiful to watch in flight or on a perch facing into wind when in a flock.

Laughing Gull, 58

Larus atricilla

Length to 17 in., including 5½-in. tail and 1¾-in. bill. Wingspread to about 3 ft. Female smaller than male. Sexes colored alike, upper parts of wings being mostly dark gray but with conspicuous white border along hind margin of wings. Head and throat white in winter but dark slate in summer, over a smaller area than in Franklin's gull. Young show white rump.

Breeds from Maine to Florida, Texas, southern California, Venezuela, and Lesser Antilles. Winters south from South Carolina and Gulf Coast to Brazil, Peru, and Chile but occasionally found inland to Quebec, Iowa, Wisconsin, Nebraska, and Colorado. Also found sometimes in Europe and Bermuda. Found along Atlantic Coast of North America, April–September.

Nest in colonies, usually on sea islands and often with terns, on ground, often a mere depression, but frequently well-built of vegetable materials, concealed or not. Eggs 2–5, 2½ by 1½ in.; brown to cream to buff to green, sometimes marked with brown or purple. Incubation about 20 days. 1 annual brood. Nesting period April–June.

Food almost any available animal matter, living or dead. Has record of being exceptionally good insect destroyer. Probably does not dive for food but gleans it from water surface or shore. May rob terns and other smaller birds of food but will also gang up on and rob pelicans. No record of its destroying other birds' nests, though it may.

Chief value is as scavenger and as destroyer of insects. Flocks of the bird are of great beauty. May be confused with Franklin's gull, whose extreme wing tips are white with touches of black, while laughing gull has black wing tips with white only at extreme tips of a few feathers. Legs of these gulls dark red or brownish-gray.

Bonaparte's Gull, 60

Larus philadelphia

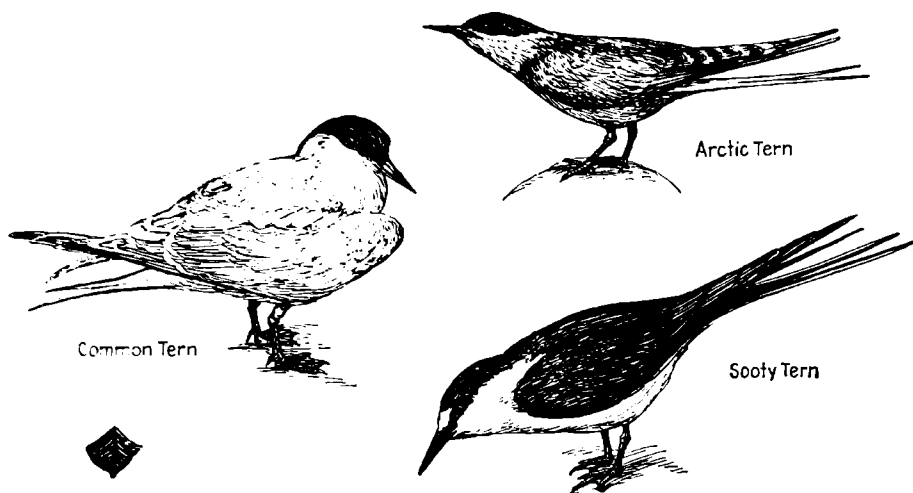
Length to 14½ in., including 4-in. tail and 1½-in. bill. Wingspread to 32 in. Female smaller than male. In breeding plumage, back gray, body white, with margins of wing tips almost black but rest of wings white, with face and fore half of head dark-gray to black, bill black, and legs red. In winter, head may be mostly white except for spot behind eye.

Breeds from northwestern Alaska and northern Mackenzie to central British Columbia and central Alberta. Has been found during breeding season but not breeding from New Jersey to Rhode Island. Winters from Maine to Florida, on to coast of Yucatan; on Pacific Coast, from Alaska to Lower California and western Mexico; also accidentally in Great Britain, Peru, and France.

Nests in colonies on forested lake area, inland. Nest on stumps or in trees, often 20 ft. above ground, usually in cone-bearing trees. Nest of sticks and twigs, with softer lining. Eggs 2–4, 1½ by 1½ in.; olive gray to dark olive or brownish, with chocolate markings. Nests June–July. 1 annual brood.

Food usually small fish but during summer months is one of best insect destroyers, consuming large quantities of flies, ants, moths, and the like. Not known to feed on any crops grown by man. Call a rasping plaintive cry or whistle, but usually rather silent for a gull, except near nest, where it attacks without provocation.

Undoubtedly a useful bird so far as man's interests are concerned. Best field characters include red legs, white triangle with black tips found at wing tips, black bill, and dark head. Immature birds have a narrow dark band near tail tip as well as black spot behind eye common to adults in winter plumage.



Common Tern

Arctic Tern

Sooty Tern

PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Laridae. GULLS, TERNS

Common Tern, 70
Sterna hirundo

Length to 16 in., including 7-in. tail that is forked half its length and $1\frac{1}{2}$ -in. bill. Wingspread to 32 in. Female smaller than male; young as short as 9 in. Lower face, neck, belly, and tail pure white. Upper wing surfaces and back light blue-gray, with ends of wings dusky. Bill orange-red with black tip. Feet orange-red. Black caps restricted to nape in winter.

Breeds from Great Slave Lake to northern Manitoba and Gulf of St. Lawrence, south to North Dakota and North Carolina; also in Bahamas and on coast of Venezuela, West Indies, Gulf Coast, Europe, Asia, and Africa. Winters from Florida to western Mexico and south to Straits of Magellan.

Nests on islands, in sea or lake or marsh, a mere hollow or well-built mass of vegetation, sometimes on bare rock. Eggs 2-6, $1\frac{3}{8}$ by $1\frac{1}{8}$ in.; highly variable in shape and color even in same nest, from white to buff, olive, or green, with or without markings. Nesting period June-July. Incubation 21 days, by both sexes. 1 annual brood.

Food chiefly small fish, but also insects and other small animals. Flying ants, butterflies, and cicadas seem to be favored. While birds can rest on water, they seem much more at home in air. Will work in concert helping a wounded companion or fighting a common enemy. Resembles Forster's tern but has darker wing tips.

Useful to fishermen as indicators of location of schools of fish. Probably never eat marketable fish themselves and do destroy many injurious insects. Part of sea's beauty and always worth watching. Common tern is not so common everywhere as closely related Forster's tern.

Arctic Tern, 71
Sterna paradisaea

Length to 17 in., including 8-in. tail with 5-in. fork and $1\frac{3}{8}$ -in. bill. Wingspread to 33 in. Cap black. Tail white. Bill slender and all red. Throat and belly white. Upper surface of wings gray, with rear half much darker. Feet bright red. Red of feet and bill is much richer than in common and Forster's terns.

Breeds from northern Alaska to Baffin Bay, northern Ellesmere Island, and Greenland, south to southeastern Alaska, northern Manitoba, and Maine and in Arctic Europe and Asia. Winters in Antarctic Ocean south to 74°S.L. Seen in migration along Atlantic and Pacific coasts of North and South America and in Africa.

Nests on rocky or pebbly shores of lake or sea islands, with little or no nesting material. Eggs 2-3, $1\frac{3}{8}$ by $1\frac{1}{8}$ in., highly variable in color. Nesting season June-July. Incubation 21 days, by both sexes. 1 annual brood. Downy young have dusky patch on forehead, unlike other young terns, but otherwise are much like common terns.

Food chiefly small fish, crustaceans, and other small forms of animal life picked up for most part while in flight over surface of water. Seems to prefer nesting by itself rather than in colonies of other related birds. From May-July in Arctic is rarely seen over 100 miles from land.

Probably not of great economic importance but of intense interest to bird students because each year it travels from the Arctic to Antarctic and return. Except during breeding months, it may be seen at almost any distance from land over almost any ocean. Journey from Arctic to Antarctic each year allows it to enjoy more sunlight than any other bird.

Sooty Tern, 75
Sterna fuscata

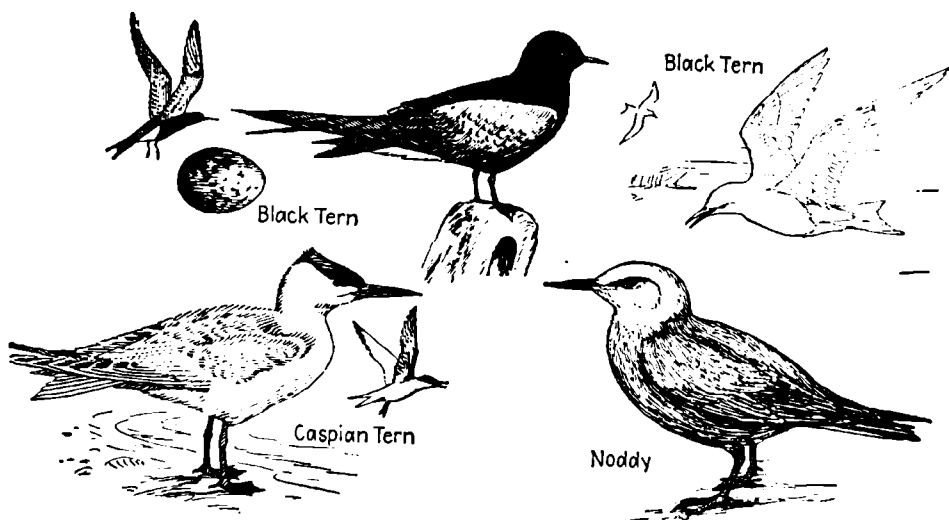
Length to 17 in., including $7\frac{1}{4}$ -in. tail with $3\frac{1}{2}$ -in. fork and $1\frac{3}{10}$ -in. bill. Wingspread to 34 in. Sexes colored alike. Cap greenish-black. Forehead white. Throat and forward part of neck and breast, white. Back, tail, and upper surface of wings sooty black in breeding plumage. In winter white feathers mixed with dark in crown.

Breeds in Dry Tortugas, West Indies, and tropical islands of the Atlantic from Venezuela to British Honduras and formerly to Texas. After breeding season, may wander north along Atlantic Coast to Nova Scotia. Winters from Brazil and Louisiana to Falkland Islands. Has been found on occasion in England and in France.

Nests in colonies, many times of enormous numbers, on sand of islands, a mere depression, or nothing. Eggs 1-3, $2\frac{1}{10}$ by $1\frac{1}{2}$ in.; white, cream, or buff, slightly spotted with brown or purple but highly variable. Incubation 26 days. 1 annual brood. Nesting season April-May. Downy young sooty or gray streaked above, dull white beneath.

Food, small animals of the sea including, of course, fish. Of more limited range than most terns here considered but is one most easily recognized by its contrasting black and white, with dark areas more extensive than in most terns. Often blown out of its normal range by cyclonic storms and records from remote places usually follow such storms.

Probably of little economic importance; to ornithologists in northern Atlantic points it is of chief interest as a rather unusual visitor. It probably takes over a year for birds to develop fully mature plumage. Related socorro and bridled sooty terns extend range to Pacific Coast.



PHYLUM CHORDATA. CLASS AVES
Order Charadriiformes. Family Laridae. GULLS, TERNS

Black Tern, 77
Chlidonias nigra

Length to 10½ in., wingspread 25 in., tail ¾ forked, to 1 in., bill, 1 in. Head and under parts of body black, back and wings gray with narrow light streak along front of wing, in breeding plumage. Young and winter adults with head and under parts white and back and wings gray, general appearance mottled.

Breeds in interior of North America, from central eastern Alaska, to central New York and south to California, Nevada, Missouri, Tennessee, and Pennsylvania. Winters from Surinam to Peru and Chile. Appears regularly along Atlantic Coast in late summer and autumn.

Nests in colonies, in marshes or wet areas. Nest of plant materials, sometimes floating, sometimes well-made, and sometimes of little structure. Eggs 2-5, olive to yellow to brown and pointed at one end, 1½ by 1 in. Incubation 17 days, by both sexes. 1-2 annual broods.

Food largely insects, picked up in flight or from ground. Often over cultivated lands and also eats small fish, mollusks, and crustaceans. More of an insect eater than common tern. Its short tail, deep wing beats, darting flight, dark body, and small size are good identification points.

Where abundant, black terns may be valuable as checks on insect enemies of agricultural crops, but over most of the range species is not sufficiently abundant to be considered important. No justification for their being killed at any time.

Caspian Tern, 64
Hydroprogne caspia

Largest of the terns. Length to 23 in., wingspread to 55 in., tail to 6¾ in., forked 1½ in., bill to 3 in. Distinguishable from herring gull by forked tail, black crown, and large red bill. Caspian tern, tail forked ¼ its length; royal tern, tail forked ½ its length. Arctic, common, and Forster's terns smaller than Caspian.

Caspian tern breeds from Great Slave Lake to Gulf of St. Lawrence and south to central Lower California, Texas, Louisiana, and South Carolina. Winters from southern California to South Carolina and Mexico. Similar royal tern nests only from Virginia to Texas.

Nests in colonies, on ground, with or without any nesting materials. Eggs 1-3, broad, buff, sparingly marked with brown and gray, 2¾ by 1⅞ in. Incubation about 20 days. 1 annual brood. Young birds downy, then frowsy, then feathered. First winter plumage pale gray. Adults have 2 complete molts each year.

Food, small fish and other animals which swim at surface of sea, also mussels and eggs and young of other kinds of birds. Surface feeding worth watching, as birds fly swiftly with bill down, ready to grab whatever appears.

Probably does little damage except in destroying eggs of other terns. Rarely sufficiently abundant to be considered a pest; at all times worth watching in exceptional flying antics.

Noddy Tern, 79
Anous stolidus

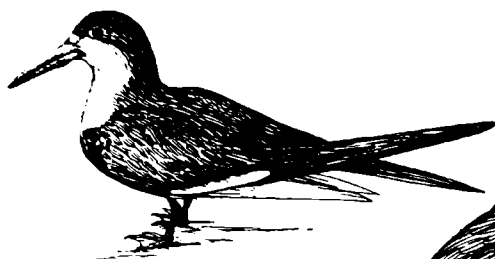
Length to 16 in., including 7-in. tail and 2-in. bill. Tail not forked. Top of head grayish-lavender to white, with a black band from bill to eye. Upper parts dark-brown, with main tail and wing feathers black. Under parts dark-brown but lighter under wings. Bill black. Feet brownish-black with yellowish webs.

Breeds throughout most of year in one form or another, since there are races in Indian and Pacific Oceans as well as in Atlantic. Found near tropical and subtropical seas of world except on west coast of South America. Nests with sooty terns on Dry Tortugas during April-May.

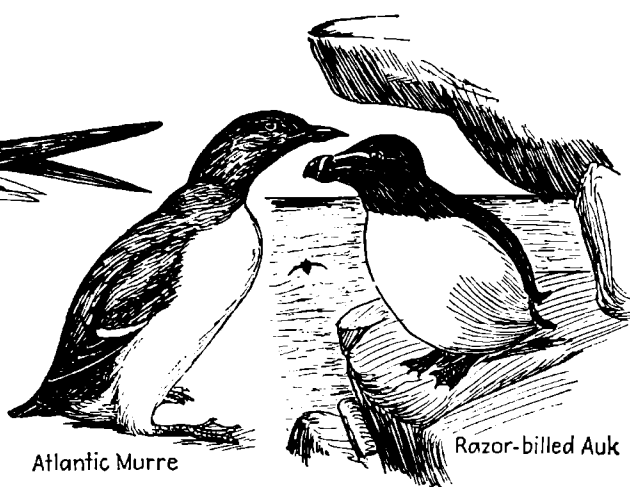
Nests on branches of trees or shrubs. Nest of seaweed and other vegetation piled rather carelessly together. Egg, 1, variable, 2 by 1½ in. Young down-covered when hatched, more or less yellowish with darker markings. Both parents aid in defense and feeding of young. Young begin to wander from nest relatively soon.

Food mostly small animals like fish gleaned for most part from sea while in flight. Terns in general are not scavengers as are gulls and so feed on living insects, crustaceans, fish, and like. Common noddy tern is only slightly larger than lesser noddy, with darker crown than white-capped noddy.

Probably from an economic standpoint noddies cannot be justified since they feed largely on living fish that have an indirect use to man even though fish eaten are themselves too small for food for man. Seen far out at sea at almost any time of year, but only in tropical or subtropical areas.



Black Skimmer



Atlantic Murre

Razor-billed Auk

PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes

Family Rhynchopidae

Black Skimmer, 80

Rynchops nigra

Length to 20 in., including 6-in. tail with 1½-in. fork, and long bill, lower part being to 4½ in. long while upper bill is to 3 in. long. Wingspread to 50 in. Female smaller than male. Like slender long-billed gull, with black upper parts and white under parts. Bill much compressed, red, and black-tipped.

Breeds along Atlantic Coast of North America, from Long Island to Florida and Texas, sometimes wandering to Bay of Fundy and Lake Ontario. Winters from Gulf Coast to northern and eastern coasts of South America. Has been found inland to Tennessee. Allied race is found in interior of South America.

Nests in colonies, on high sand flats and shell beaches. Nest a mere depression, without vegetable lining. Eggs 3-5, 1½ by 1½ in.; white, greenish, or buff, spotted or blotched with brown, gray, or lavender. Incubation probably only by female. 1 annual brood. Nesting period mid-May-mid-July.

Food almost wholly small fishes and crustaceans. Flies gracefully close to surface of water with long lower bill skimming or cutting surface. May wade in shallow water, turning bill on side to capture food. Bills of young birds are more nearly equal than those of adults, so they can pick food from surface of ground.

Probably of no economic importance and certainly not sufficiently abundant to be serious enemy of any living thing useful to man. Eggs large and illegally eaten by man, but flesh is not edible. Egg collectors have probably eliminated species over much of its original range.

Atlantic Murre, 30

Uria aalge

Length about 17 in., including 2½-in. tail and 2½-in. bill. Wingspread to 30 in. Female smaller than male. Dark sooty-brown above, with darker areas sometimes showing on wings. Breast and abdomen white. Sides more or less streaked with black and white. Bill of related Brunnich's murre heavier with pale bluish stripe at base.

Breeds from southern Greenland through Labrador and Gulf of St. Lawrence to Nova Scotia, and along northwestern Europe, Iceland, and Shetland Islands. Winters south to Maine and sometimes into Massachusetts, and in Europe down to Mediterranean and coast of Morocco. Sometimes found in Hudson Bay.

Nests in colonies, on islands, out to sea. Nest, none. Eggs laid on bare ground, often even in no depression. Egg, 1, 3½ by 2 in.; light green to blue or cream, washed, spotted or marked with brown, lavender, or olive. Incubation about 30 days. 1 annual brood. Nesting period late May through July. Young by first winter like adults but smaller. Downy young gray-brown.

Food, small fishes, crustaceans, and other marine animals. Murres can dive almost instantaneously and swim vigorously under water with assistance of their wings; in fact, they can swim with wings under water more rapidly than they can swim with their feet on water surface. Brunnich's murre is common somewhat farther south than Atlantic murre.

Murres, like other sea birds, have been killed by thousands by seagoing men and by others. Eggs were easily collected and provided a fresher food than was formerly available on long voyages. Egg has a red yolk and a sky-blue surrounding albumen when fried. Eggs have been prized by collectors and this has reduced numbers unreasonably.

Family Alcidae

Razor-billed Auk, 32

Alca torda

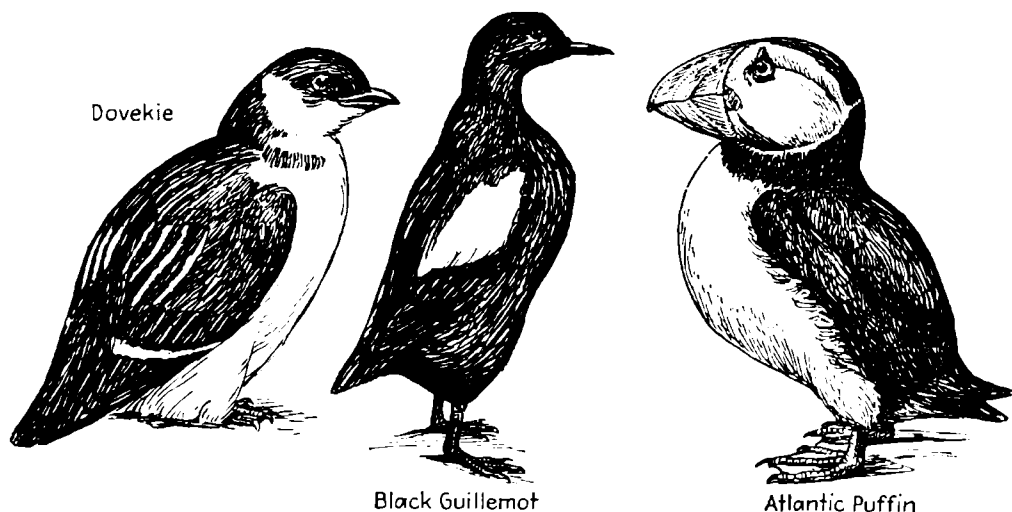
Length to 16½ in. Tail to 3½ in. Bill to 1¼ in. Wing to 7¼ in. Tail of 12 feathers forming a wedge. Head, neck, and under parts black with white line from eye to beak. Under parts white. Beak narrow, deep, crossed by white band, with inside of mouth yellow. Feet black.

Ranges through North Atlantic, sometimes on American coast south to North Carolina but mostly north of Maine. On European side it ranges south to Azores and Gibraltar. Winter range on our coast may bring birds south to Long Island. Breeding range is Gulf of St. Lawrence area northward.

Breeding period is June-August. Nesting done in colonies on rocky cliffs where egg is laid on rock without a protective nest, usually in a cranny. During incubation period, birds give hoarse grunts or groans. Egg pale blue, gray, or white with chocolate speckles; 3 by nearly 2 in.

Food almost exclusively fish caught by a lightning-like dart of head. Underwater swimming is done with help of wings. In swimming on surface bird carries tail raised. In early days, related great auk was sought by men for feathers, flesh, and oil but since 1844 no living great auk has been found.

In Greenland, auks today provide food and clothing for natives. May be considered as enemies of fish but not so seriously that they should be forced to follow way of the related great auk. Superficially auks may have some resemblance to penguins of Southern Hemisphere, but are not closely related.



Dovekie

Black Guillemot

Atlantic Puffin

PHYLUM CHORDATA. CLASS AVES

Order Charadriiformes. Family Alcidae. AUKS, MURRES, PUFFINS

Dovekie, 34 *Plautus alle*

Length to $9\frac{1}{10}$ in., including $5\frac{1}{2}$ -in. tail and $\frac{1}{2}$ -in. bill. Wingspread to $15\frac{1}{2}$ in. Female smaller than male. Upper parts, head, neck, and breast black. In winter, throat is whitish and nape sometimes gray. Under parts, including lower breast and abdomen, white. Bill short, thick, and black; yellow inside. Feet flesh-colored.

Breeds on northern coasts of Greenland, Iceland, Spitsbergen, and Novaya Zemlya. Winters from southern Greenland to New York or even to South Carolina; in Europe, to Azores and Canary Islands. Sometimes after severe storms at sea many are blown inland. Essentially a sea bird, about size of starling, and conspicuously black and white.

Nests on cliffs or exposed rocks, usually in crannies of loose rubble. Nest a mere depression or sometimes with a lining of vegetation. Eggs 1 or rarely 2, $1\frac{3}{8}$ by $1\frac{1}{8}$ in.; pale greenish-blue and usually unmarked. Nesting period June-July. Incubation 24 days, by both parents. 1 annual brood. Downy young sooty above and lighter gray beneath.

Food mostly marine animals such as small fish, crustaceans, and similar organisms but also known to have seaweed in stomach. Young are fed crustaceans carried in considerable quantities in parent's gullet. Call a harsh *squeak*. Found in considerable flocks far out at sea, in almost any weather, flying or diving. Use wings under water.

Of little direct economic importance to most men, but a lifesaver to residents of Far North where the Eskimos eat the birds and their eggs in season. Is known as a "little auk." Perfectly at home in air or on water but almost helpless on land.

Black Guillemot, 27 *Cephus grylle*

Length to 14 in., including 2-in. tail and $1\frac{1}{2}$ -in. bill. Wingspread to 23 in. Male usually slightly larger than female. Sexes colored alike. Upper parts black with greenish sheen. Under parts slightly lighter than upper parts. Conspicuous white patch shows on upper part of wings near body. Downy young sooty-black above and paler beneath.

Breeds from central Labrador south to Nova Scotia and Maine, and in Europe from Scandinavia to northern Scotland and in Iceland. Winters in America, from Cumberland Sound south to Cape Cod and sometimes to New Jersey; in Europe, south to northern France. Mandt's guillemot, a subspecies, ranges farther north; pigeon guillemot is found along Pacific Coast.

Nests on cliffs, near the sea, on sea islands, usually in some inaccessible place far back in some rock crevice, rarely in open on bare rock. Eggs 1 or more commonly 2, $2\frac{1}{2}$ by $1\frac{3}{8}$ in.; nearly elliptical; white, blue, green, or creamy with larger spots, if any, near larger end. Nesting date June-July. Incubation 21 days. 1 annual brood.

Food, small fish, mussels, shellfish, crustaceans, and sea worms for most part. Known to eat some seaweed. Flies usually swiftly and close to water, with white wing patches showing conspicuously and red feet stretched out behind. Under water, uses wings in swimming and can move about rapidly there. Takes to air easily. Call a faint, piping whistle.

Not of any great economic importance. Sailors feel that a group of 6 or more probably indicates that land is within 25 miles while a smaller number is probably found only within 50 miles of land. They are, therefore, usually within sight of land themselves.

Atlantic Puffin, 13 *Fratercula arctica*

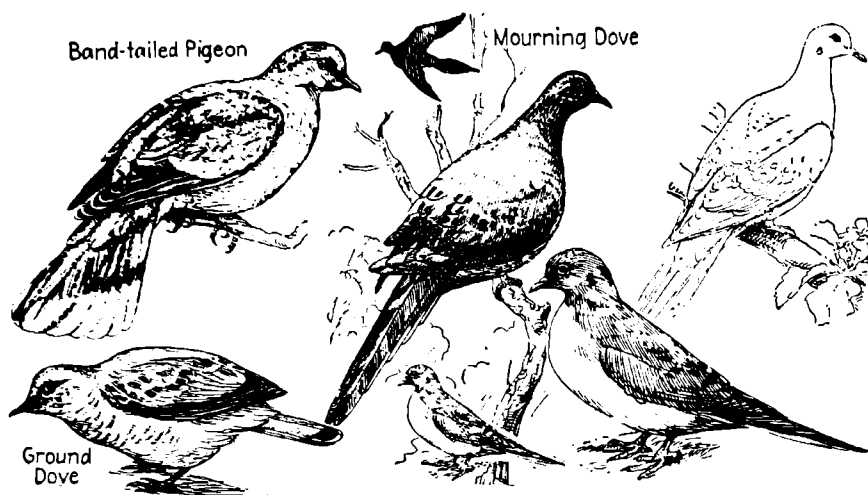
Length to $13\frac{1}{2}$ in., including $2\frac{1}{2}$ -in. tail and $1\frac{9}{10}$ -in. bill. Wingspread to 24 in. Female smaller than male. Sexes alike. Upper parts, wings, tail, and collar blackish. Face grayish-white in summer, smoky in winter. Breast and abdomen white. Feet orange. Bill large and parrot-like but not hooked, deeply ridged, marked with red, yellow, and blue.

Breeds from southern Greenland and Ungava Bay south to Nova Scotia, Bay of Fundy, and Maine, also in Norway and from British Isles to Portugal. Winters south to Massachusetts or New York and New Jersey and in the Old World to Morocco and Azores. Definitely a bird of the sea where there are rocky shores.

Nests in large colonies on sea islands, usually in burrow in soil or in natural crevice under rocks. Eggs 1, $2\frac{1}{2}$ by $1\frac{3}{8}$ in.; granular, dull white, sometimes marked with purple, brown, or chocolate. Nesting period June-July. Incubation 36 days, with both parents caring for eggs and for young. 1 annual brood. Young can follow parents to sea at 4 weeks.

Food mostly fish but probably also crustaceans and mollusks; caught by diving, using wings under water for power and legs for steering. Call a harsh croaking. Flight by rapid wing beats. Swims well but may have difficulty in taking to air from level ground. During fall molt in August-September, flight feathers are shed and birds cannot fly.

Sailors consider that puffins are land indicators, direction of their flight at morning and evening locating land. Any number larger than 3 indicates that land is probably within 150 miles, number increasing as land becomes nearer. Eggs have been used as food by men. Now that species has been given complete legal protection it is increasing.



PHYLUM CHORDATA. CLASS AVES
Order Columbiformes. Family Columbidae. PIGEONS AND DOVES

Band-tailed Pigeon, 312
Columba fasciata

Length 15½ in. Upper parts of back brown, lower part gray. White collar on back of neck, with wash of bronze back of this on other feathers. Under parts purplish-pink, but abdomen almost white. End of tail broad pale gray, bordered with black back from tip. Hen duller, grayer, and often without collar found on cock.

Breeds from southwestern British Columbia through Montana to north central Colorado, and south through southwestern United States and Mexico to Guatemala; east to western Texas. Winters in southern part of range from southwestern United States south. Related to extinct passenger pigeon that formerly ranged over most of eastern North America.

Nests in trees. Nest usually single, a crude, almost flat platform of rather coarse sticks. Eggs, 2, 1½ by 1¼ in.; white, creamy, unmarked; equally rounded at both ends. Nesting period May-June, birds sometimes nesting in scattered colonies. With passenger pigeon, there might be to 50 nests in single tree, with adjacent trees equally crowded.

Food primarily seeds and grains, though some insects are included. When bird has fed on grain, usually waste, may develop a fine flesh. Flight is strong but not too fast, and bird makes a relatively easy shot.

Considered in some places a legitimate game bird but its numbers have been greatly reduced and it is doubtful if it is frequently injurious to crops. Its abundance should be maintained so that it does not become extinct like its relative, the passenger pigeon, which used to yield millions of birds a year.

Ground Dove, 320
Columbigallina passerina

Length to 7 in., or about size of bluebird. Wingspread to 11 in. Male: under parts pinkish-drab, breast with scale-like markings, under surface of wings auburn, tail rounded and brownish-black, base of bill red with black tip. Female much like male but browner, with under parts mouse gray.

Breeds from South Carolina to southeastern Texas, through the Gulf and South Atlantic States, but most abundant near coasts. Accidentally found north to Tennessee, New York, and intermediate states. 3 subspecies include Eastern, Mexican, and Bahama ground doves, latter 2 extending range of first to Guatemala.

Nests on ground or in trees, up to height of 25 ft. Nest small, in some cases rather elaborate and made of a mixture of plant materials. Eggs 2 or sometimes 1, white, ¾ by ¾ in.; rather equally rounded at both ends. Nesting period April-July. Young helpless when hatched but develop rather rapidly.

Food essentially seeds of plants. 10 stomachs examined contained mostly seeds such as crab grass, foxtail, panic grass, amaranth, purslane, ragweed, spurge, mallow, sedge, and sorghum. One stomach had 1,600 purslane seeds and another an equal number of amaranth fruits.

Probably useful as a weed-seed destroyer. Certainly too small to be considered as a game bird though some hunters may think that any dove or pigeon should be a legitimate target.

Mourning Dove, 316
Zenaidura macroura

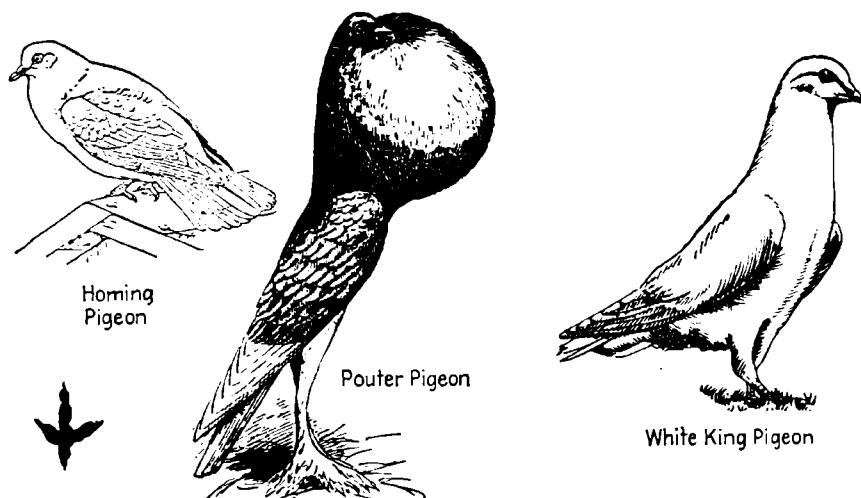
Length to 11 in., wingspread to 19 in., tail to 6¾ in., bill to ¾ in. Weight 3-6 oz. Female smaller than male. Temperature, 106°F. A brown pigeon with a pointed white-bordered tail, smaller than extinct passenger pigeon, which lacked also black spot behind eye and had a blue-gray head.

2 subspecies. Breeds from New Brunswick to British Columbia and south through interior of America through Mexico and Bahamas. Winters from Iowa and Massachusetts, west and south to Panama. Related passenger pigeon, *Ectopistes migratorius*, ranged from Nova Scotia to Washington and south to Gulf; extinct since 1914.

Nest on ground or as a crude stick platform relatively low in trees. Eggs usually 2, weight, ¾ oz., white, elliptic, 1½ by ¾ in. Incubation by both sexes, 12-14 days. Young helpless when hatched, but assume practically adult plumage by first fall. 2 or sometimes more annual broods.

Food, grains and various seeds, particularly buckwheat. 99% vegetable material, of which 32% is grains, mostly waste. One stomach showed 7,500 seeds of yellow wood sorrel; another, 6,400 of barnyard grass; another, 2,600 of joint grass; another, 4,820 of orange hawkweed; another, 950 of hoary vervain; another, 620 of panic grass. Speed, 41 m.p.h.

Economic importance varies with locality. Where numbers are great and grain is abundant, there may be damage but weed-seed destruction must not be overlooked, particularly in areas not raising grains. Bird unfortunately is considered a game bird in southern states.



Homing
Pigeon

Pouter Pigeon

White King Pigeon

PHYLUM CHORDATA. CLASS AVES

Order Columbiformes. Family Columbidae. PIGEONS AND DOVES

Homing Pigeon, \$13.1

Columba livia

Homing pigeon, common pigeon of towns and farmyards, varied in color, blue, reddish, or almost black. Racing Homer should weigh 1 lb. as contrasted with larger flesh-producing breeds, of which, strange to say, largest is the Runt. Some 200 varieties of pigeons are recognized.

Homing pigeons, like others, probably were developed from Rock dove, *Columba livia*, though some authorities have it developed from Stock dove, *C. aenas*. Left to breed promiscuously, however, resulting stock most nearly resembles *C. livia*. In breeding practice, it is best to mate birds of different colors except for show.

Young, blind and helpless when hatched, for 5 days are fed "pigeon milk," a cheesy secretion from crops of both parents, then fed regurgitated, partly digested grain. By 4 weeks, young reach maximum size. At 6 weeks, young molt. Training for flying may be begun at 9-12 weeks. May live 16 years. Flight speed, 67 m.p.h.

When birds are trained for flying, they are freed first 1 mile from home cote. Then, 1 mile a day is added until 25 miles are reached. Then, this may be jumped to 50 miles. Adult cocks fly best if freed so as to reach home to their young just before dark. Hens, best when with 10-12-day eggs in nest. Should not be flown when breeding.

Homing pigeons used in war and in peace can, when racing, maintain flight for 13 hours, can speed 1,200 yd. per min., can fly 2,600 miles to return home. Home may be on a moving ship and yet be found, or may be moved about on land to a certain degree. Birds are usually bred only between February and September, and are then rested.

Pouter Pigeon, \$13.1

Columba livia

Length to 20 in.; pygmy pouter to 14 in. Thigh to middle toenail, to 7½ in.; pygmy to 5½ in. Blue, black, red, yellow, or white, but typical marking has a 2-in.-wide crescent of white on front of enormous crop. Birds with bib lacking are "swallow-throated" and those with it around neck are "ring-necked" and poor showbirds.

Pouters were probably developed in Europe or Asia and probably represent breed farthest removed from original blue-rock type. Some 200 varieties of domestic pigeons of which Carrier, Pouter, Barb, and Tumblers are possibly most important. Some can barely fly while others may fly long distances for long periods of time.

Selection by breeding has developed carrier with homing instinct, pouter that inflates chest while strutting; barb that is plump, short-legged, and broad-skulled; tumbler that somersaults in air; fantail, with enormous tails; jacobin, with a feather ruff; and many others.

Pouter must have a dignified walk while crop is inflated. It must not choke while walking nor jump off ground as do the "croppers," nor set up rump feathers but must hold head and feet in a perpendicular line while it walks gracefully. Pouter must, for judging purposes, turn the middle toes outward and limbs must be properly feathered.

Pouters are essentially showbirds. In addition to raising pigeons for homing and for show, a big industry centers around raising them for flesh. Squabs are a standard dish in many city hotels and some birds are fed special diets to improve the quality of their flesh. There is a rich literature on this aspect of pigeon raising.

White King Pigeon, \$13.1

Columba livia

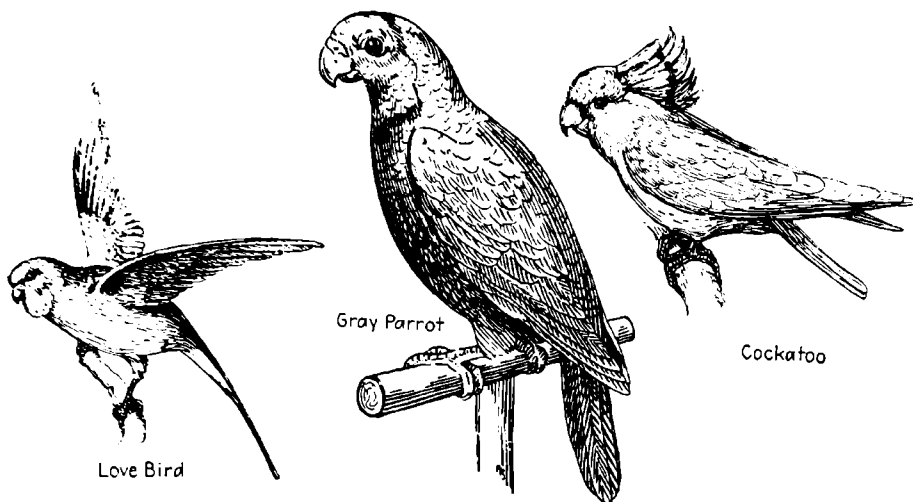
Varieties include White King, Runt, Homer, Fantail, Pouter, Tumbler. Body temperature, 104°-108°F. White King cock: weight to 26 oz.; hen, to 24 oz. Toes, 4, all on same level. Beak slender, with fleshy growth around nostrils. Sexes colored alike. Other varieties differ in color and size.

King pigeon developed in United States about 1891 as a meat producer. Pigeons have been domesticated for over 3,000 years, tracing ancestry probably to Rock pigeon, still wild in Europe and Asia. Pigeons commonly live in flocks around a protected shelter, usually a building.

Pigeons are monogamous. Courtship by strutting, cooing, and billing. Nest site selected by cock. First egg laid 8-12 days after mating; second, 2 days later. Incubation, 10 A.M.-4 P.M. by cock and remainder by hen, for 16-18 days; when domesticated, in a 12 by 12-in. box, 9 in. deep, lined with straw.

Food essentially grain, such as wheat, buckwheat, and pigeon peas. Cracked corn should not be fed unless it is freshly cracked and free from mold. "Pigeon milk" for young is secreted in the crops of each parent when it is needed, just after young are hatched. Young helpless at first. Hearing range, 200-7,500 c.p.s.

Pigeons are reared for their meat, as with King described above; for carrying messages, as with Homer; and for exhibition purposes, as with Tumbler, Pouter, Fantail and others.



PHYLUM CHORDATA. CLASS AVES
Order Psittaciformes

Family Psittacidae

Family Kakatoidae

Lovebird

Melospittacus undulatus

Length to 8 in., including 4-in. tail. Tail of parakeets, of which this is one, pointed; of parrots, square or rounded at tip. Neck, cheeks, upper back, and wing coverts gray, each feather being marked with alternating crescents of yellow and green. Central tail feathers blue; others blue-green. Bill horn-colored.

Native of central and southern Australia, breeding in southern area. Trapped mostly during migrations of great flocks. Reared by thousands in captivity over world, particularly in western Europe. African *Agapornis* and South American *Psittacula* are also known as lovebirds and kept in cages.

Nests in captivity in boxes with curved bottoms or in old coconut husks suspended with hole toward light. Should be 2 nest boxes per pair. Breeds August-July in wild but in cages may breed April-July. Eggs to 6, incubation of 17 days beginning with laying of first egg. Hen alone incubates but cock feeds family.

Food, seeds like millet; will starve on "birdseed" of rape, maw, flax, and hemp. Can go without water for months but needs it regularly nevertheless. May nest 3 times in a year; an aviary 14 by 9 by 7 ft. may care for 8 pairs if no old unmated hen is present to upset families. Young may breed at 3 months.

Desirable cage birds, admired because of beauty and because of evident affection and consideration shown between paired birds. Can be taught to perform simple tricks. May be carriers of "parrot fever" and so importation is restricted.

Gray Parrot

Psittacus erithacus

Length about 12 in. Tail scarlet; general color ashy-gray. Feet and toes gray. Green or Amazon parrot is *Chrysotis amazonicus*, a green bird with yellow head and square tail. Parrots have 4 toes, 2 in front and 2 behind.

Gray parrot is native of western Africa. Yellowhead parrot comes from country about Amazon River in South America and is found north into Mexico. Festive parrot, *Chrysotis festivus*, also a cage bird, is 16 in. long, green and red, and also comes from Amazon region, where it lives naturally in jungles. Nearly 100 species.

Like pigeons, parrots mate for life, even though they live naturally in great flocks. Naturally nest in holes in trees or in banks in ground though this varies with species. Hen lays from 2-8 white eggs, which at parrot's body temperature of around 106°F. hatch in from 25-30 days. Long-lived.

Food of parrots varies. In captivity, young birds are fed soft foods like bread and milk but older birds eat seeds, crackers, fruits, vegetables, and a variety of other foods. Captive birds must be kept clean and well-supplied with fresh air if they are to thrive and make interesting pets, some imitating human speech.

Mostly known as cage birds. Gray parrot can best be taught to "talk." Tongue splitting does not help in this. Parrots carry a disease, psittacosis, which may be fatal to persons who come in contact with them or their cages and therefore parrots are no longer imported. Native Carolina parakeet extinct since 1904.

Cockatoos

Kakatoë et al.

Pink cockatoo (*Kakatoë leadbeateri*); sulfur-crested cockatoo (*K. galerias*); great black or palm cockatoo (*Microglossus aterrimus*); and black cockatoo (*Calyptorhynchus funereus*). Pink or lead-beater cockatoo is white, with neck and breast delicately tinged with pink and crest striped red, yellow, and white. Sulfur-crested cockatoo is white with showy sulfur-yellow crest.

Cockatoos come for most part from Australia and islands of the Indian Ocean, where they live normally in forested areas and favor warm climates though rose crested and sulfur-crested cockatoos can survive living outdoors even in winter in New York if shelters are available into which they may retire in severe weather.

Nests made in hollows in decaying trees in native haunts. In related cockateel, 7-9 eggs are usually laid, although as many as 20 may be; incubation 17-18 days; mother not fed by male during incubation. Young with down when hatched, but feathers soon appear. Both parents assist in rearing. 2-4 annual broods, April-October.

Cockatoos are full of tricks and play together most boisterously. They can be taught to talk as do parrots but this is not a common accomplishment. While they are commonly noisy, this is not true of contented birds. Cockatoos are larger than more common parrots and so require larger quarters to thrive.

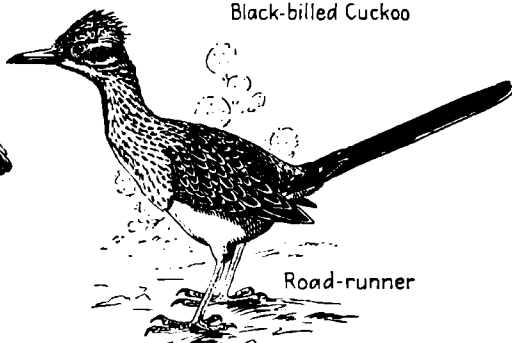
Relatively common cage birds, whose importation is not now possible because they may carry the fatal disease psittacosis. Food for captive birds is sunflower seeds, hempseed, and oats, with bananas, grapes, and apples also available.



Yellow-billed Cuckoo



Black-billed Cuckoo



Road-runner

PHYLUM CHORDATA. CLASS AVES
Order Cuculiformes. Family Cuculidae. CUCKOOS

Yellow-billed Cuckoo, 387
Coccyzus americanus

Length to 12 $\frac{3}{4}$ in., including 6 $\frac{1}{4}$ -in. tail and 1-in. bill. Wingspread to 17 in. Weight just over 2 oz. Sexes colored alike. Slim, brown and white, with reddish cast to wings and large white tips to tail feathers that appear as an almost continuous band when tail is spread; not gray as in Black-billed cuckoo; outer tail feathers almost black. Lower mandible yellow.

Breeds from North Dakota to New Brunswick and south to Nuevo Leon, Tamaulipas, Louisiana, and southern Florida. Winters in Venezuela, Colombia, Ecuador, and Uruguay. Migrates through Mexico, West Indies, and Central America. Also found occasionally in Greenland, Great Britain, Italy, and Belgium. Bird of woodlands, orchards, and tall brushlands.

Nests in trees and tall shrubs near borders of woodlands. Nest a shallow, poorly constructed platform of sticks and twigs, sometimes with a lining of finer materials, 4-20 ft. above ground. Eggs 2, to rarely 8; 1 $\frac{1}{2}$ by $\frac{5}{16}$ in.; light blue, sometimes paler than Black-billed cuckoo, with white mottlings. Nesting period June-July. Incubation 14 days, probably by both parents. 1-2 annual broods.

Food largely caterpillars, particularly hairy species that are avoided by most other birds. One was seen to eat 41 gypsy moth caterpillars in 15 minutes; another, to eat 47 tent caterpillars in 6 minutes. Also eats locusts and other insect pests of useful orchard trees and shrubs. Probably eats no fruit or grain. Flight silent, graceful, direct. Call a repeated *kas* ending in *kaup*.

One of most useful birds because of its fondness for injurious caterpillars. Not known to harm other species of birds or to eat useful insects to any considerable extent. European cuckoo lays its eggs in nests of other birds, as do our cowbirds, but this is not a habit of American cuckoos.

Black-billed Cuckoo, 388
Coccyzus erythrophthalmus

Length to 12 $\frac{3}{4}$ in., wingspread to 16 $\frac{3}{4}$ in., tail to 7 in., bill to 1 $\frac{1}{4}$ in. Slender, loose-jointed, brown above and whitish beneath. Black-billed cuckoo lacks reddish color on wings of yellow-billed cuckoo, has smaller white spots at tips of tail feathers, has black rather than yellow lower mandible, and a narrow red ring around the eye.

Breeds from southeastern Alberta to southern Quebec and Prince Edward Island, south to Kansas and Georgia. Winters in South America from Colombia to Peru, and found in Greenland, Azores, Italy, and Ireland by accident. Range of yellow-billed cuckoo is somewhat more southern than that of Black-billed.

While European cuckoos commonly lay their eggs in nests of other birds, this is rare in American species. Nest, a crude platform in trees. Eggs 2-4, or rarely to 8; pale blue, sometimes marbled in their shading; 1 $\frac{1}{2}$ by $\frac{1}{2}$ in. Incubation 14 days, by both parents. 1 northern and 2 southern annual broods.

Food largely insects, particularly caterpillars; eats great numbers of fuzzy-haired caterpillars entirely ignored by most other birds. Stomachs of 46 showed 906 caterpillars, 44 beetles, 96 grasshoppers, 100 sawflies, 30 bugs, and 15 spiders. Evidence rare that a cuckoo will break up a robin's nest. Speed, 22 m.p.h.

Almost entirely useful in a way other birds are not. Of course, *coo-coo* call gives it its name; also is named rain crow but does not bring rain. Black-billed cuckoo is more likely to call at night than yellow-billed. Is protected by law and deserves even more protection. Not popular with robins.

Road Runner, 385
Geococcyx californianus

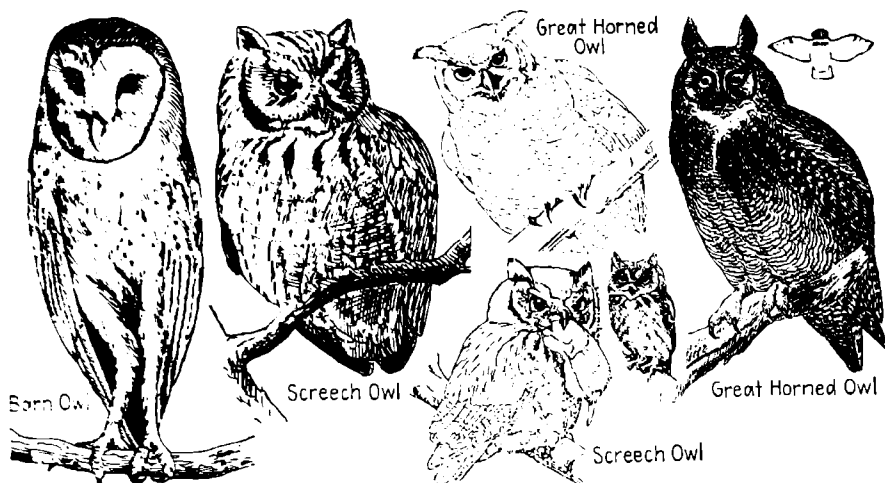
Length to 2 ft., tail 1 ft., wing 7 in. Bill downward-curved. Weight to 11 oz. Temperature, 107.4°F. Feathers coarse. Upper parts olive-brown and white-streaked. Middle tail feathers olive with purple gloss. Throat and belly white. Eye yellow to orange. Legs and feet pale blue. Sexes colored alike. Young like adults.

Resident in California and Lower California, east through Utah, Colorado, Kansas, Texas, and tableland of northern Mexico, wherever there are deserts and mesquite-covered arid and semiarid lands. Does not migrate. Found in fossil form in La Brea tar beds developed in Pleistocene of California. State bird of New Mexico.

Usually solitary but builds nest, usually unlined, about 1 ft. in diameter, of sticks and twigs, 3-15 ft. up in a low tree or shrub, where it is concealed by vegetation. Eggs 4-6, unspotted, pale yellow or white, 1 $\frac{1}{2}$ by 1 $\frac{1}{8}$ in. Incubation begins after first few eggs are laid and lasts 18 days. Mother tries to entice enemies away.

When 3 weeks old, young may begin catching their own food, which is highly varied, including snakes, lizards, scorpions, tarantulas, insects, birds and their eggs, rats, and other small animals. About 90% animal matter caught by pursuit or stealth. Runs to 18 m.p.h. for short distances to escape enemies, particularly man.

Although campaigns have been organized to destroy road runners as enemies of quail, these activities are ill-advised. Probably not one meal in 100 is of quail eggs; many more include scorpions, rattlesnakes, and other undesirable animals, particularly grasshoppers which destroy valuable crops. Deserve more protection.



PHYLUM CHORDATA. CLASS AVES
Order Strigiformes

Family Tytonidae

Barn Owl, 365

Tyto alba

Length to 21 in., wingspread to 47 in., tail to 7 in. Weight, female to 24 oz., male to 20 oz. In pairs, female usually larger but not always. Lightest colored of our owls, with face like a great white heart. Sexes colored alike. Young like adults even in juvenile plumage. Temperature, 103°F.

Resident from Washington to New York and south to southern Mexico, Nicaragua, and Gulf States. Occasionally in British Columbia, Manitoba, Minnesota, Ontario, Vermont, and Massachusetts, with allied races in Europe, Asia, West Indies, and elsewhere.

Nests in hollow trees, banks, towers, and deserted buildings, but makes no nest. Eggs 5-8, or even 11, chalky white or tinged with yellow, 2 by 1½ in., more pointed than usual owl egg. Incubation begins with first egg laid, 21-24 days or longer, mostly but not solely by female. 1-2 broods.

Family of 7 young owls requires, according to a British ornithologist, over 100 rats and other small vermin daily. One half-grown owl known to eat 9 mice one after another, though tail of last could not be downed. Stomachs of 39 showed 17 with mice, 17 with rats and other small mammals, 4 with insects.

Probably, most useful of all birds as enemy of rats and mice. Should be protected always. Illegally sold in pet shops as "monkey-faced owls" even though it may be illegal to keep barn owls in captivity.

Screech Owl, 373m

Otus asio

Length to 10 in., wingspread to 24 in., tail to 3½ in. Weight: female to 7 oz.; male to 6 oz. 2 color phases, a gray and a reddish, each with feathered ear tufts and generally streaked plumage, which is loose and easily fluffed, making bird appear unnaturally large. Eyes large, yellow, and round. Temperature, 101°F.

Resident. 15 subspecies recognized include the Eastern, the Southern, the Florida, the Texas, Hasbrouck's (Texas), Aiken's, the Rocky Mountain, MacFarlane's, Kennicott's, Brewster's, California, Pasadena, Mexican, Saguaro, and Xantus's, these covering most of United States, Mexico, and wooded Canada.

Nests in bird boxes or hollow trees, favoring orchard trees. Nest in unlined cavity. Eggs 3-7, weigh ¾ oz. each, white, usually smooth, 1½ by 1¼ in. Incubation for 21-25 days, by one sex or by both. 1 annual brood. Young white and fluffy when hatched but feathered practically like adults by first fall.

Food: stomachs of 255 showed 100 with insects only, 21 with mice, 38 with other birds, 43 empty, 21 with lizards, 9 with crawfish, 7 with miscellaneous matter, 5 with spiders, 4 with frogs or salamanders, 2 with earthworms, 2 with scorpions, and 1 with poultry. 8 stomachs contained 2,976 insects and 2 mice.

For economic importance, their record is written in stomach contents as listed above. They are essentially useful and deserving of protection. Known from Pleistocene of Tennessee, California, and Florida. Sensitive to blue light.

Family Strigidae

Great Horned Owl, 375

Bubo virginianus

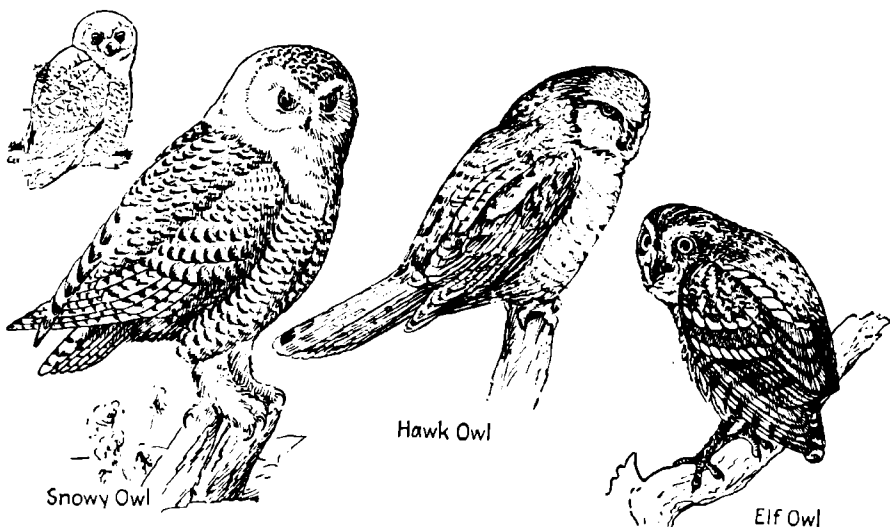
Male: length to 23 in., wingspread to 52 in., tail to 9 in., bill to 1¾ in. Weight, 3½ lb. Female: length 25 in., wingspread 60 in., to 4½ lb. Conspicuous feathered ear tufts, powerful talons and beak. Great round yellow eyes. Feathers loose. Flight quiet. Temperature, 105°F.

10 subspecies occupying most of wooded North America include the Arctic, the Labrador, the Great, the Montana, the Saint Michael, the Northwestern, the Dusky, the Pacific, the Western, and the Dwarf. Horned owls known from Pleistocene of Oregon and California. Moves south in winter. Arctic form moves even to New York.

Nests in gorges, in caves, or in heavy timber, rarely in hollow, but more commonly by remodeling nest of crow or hawk. Eggs 2-5, dull white, granular, 2¼ by 2 in. Incubation by both sexes, from 21-30 days. 1 annual brood. Young downy white when hatched but apparently adult by first winter.

Food a variety of small animals, particularly rabbits and rats. Of 127 stomachs examined, 13 had mice, 65 other mammals, 31 poultry, 17 were empty, 10 contained insects, 1 fish, 1 scorpion, and 8 other birds. 1 nest had 113 freshly killed rats on it. Animals are swallowed head first. Hoots at middle C. Hearing range, down to 70 c.p.s.

Of neutral value in a wilderness area, since it lives on animals and on their enemies as well. About game farms, and poultry yards, it may well be a menace to species being raised, but is destructive to their enemies, rats and weasels.



Snowy Owl

Hawk Owl

Elf Owl

PHYLUM CHORDATA. CLASS AVES
Order Strigiformes. Family Strigidae. OWLS

Snowy Owl, 376
Nyctea scandiaca

Length to 27 in., wingspread to 66 in., tail to 10½ in., bill to 1¾ in. Weight: female, to 5 lb., male smaller. Pure white, or with reddish- or grayish-brown fleckings on feathers. Female with more dark markings than male. Young even darker. Legs well-feathered. Ear tufts lacking.

Breeds from Bering Sea to Greenland, and south to central Mackenzie and northern Ungava; also, in northern Russia and Siberia. Winters from Arctic coast south, occasionally even to Georgia and California; also in Germany, Russia, Scotland, and Shetland Islands.

Nests on tundra in open country, only rarely where there are trees. Nest a depression in soil or on rocky shelf. Eggs 4-11, white, with smooth surface; 2½ by 1½ in. Incubation about 32 days, by female. 1 yearly brood. Young blind and helpless when first hatched; grow lighter in color with age.

Food essentially small animals. Stomachs of 38 snowy owls, 33 of which were taken in United States, showed 18 with mice, 12 empty, 9 with nongame birds, 2 with game birds, and 2 with mammals other than mice; birds taken were sea birds. May kill a few domestic fowl.

Serves as important check on mice and lemmings which, without check, would destroy most vegetation of north country. In North, then, bird is practically essential to balanced environment. May be a serious pest around game farms and may attack poultry if it is left unprotected during cold weather.

American Hawk Owl, 377a
Surnia ulula

Length to 17½ in. Wingspread to 34 in. Female averages larger than male. Sexes colored alike. Wings do not reach to tip of tail. Toes completely feathered. Dark-brown above to almost black on top of head; many feathers with small central white spot. Face pale gray, with broad blackish border, black in front of eyes and under bill.

Breeds from northwestern Alaska to Hudson Strait, south to southern British Columbia, southern Manitoba, and Ungava. Winters in southern Canada, occasionally south to Washington, Nebraska, Minnesota, Missouri, Indiana, Ohio, Pennsylvania, New Jersey, and Rhode Island. Accidental in England and Bermuda. Genus not known in fossil form.

Breeds in evergreen northern forests. Nest none, eggs being laid in hollow stump, tree hole, or in hole in a cliff. Eggs laid April-June, 4-7, 1½ by 1½ in.; elliptical, creamy, smooth-shelled. Incubation chiefly by female, length unknown, probably around 3 weeks. 1 annual brood. Eggs almost identical with those of short-eared owl.

Hunts largely by day, preying on lemmings, mice, shrews, small hares, and sometimes ptarmigan and other birds. Chief food is small mammals, even including weasels. Bird favors high exposed perch with body inclined forward rather than upright like other owls. It frequently jerks its tail as does sparrow hawk. Call a hawk-like whining screech or *queereek*.

Unquestionably a useful destroyer of undesirable small mammals. Fearless, known to attack men who approach nest. Daytime activity, fearlessness, and tendency to perch conspicuously make it a tempting target to many hunters. Normally a rare bird in United States.

Whitney's Elf Owl, 381
Micropallus whitneyi

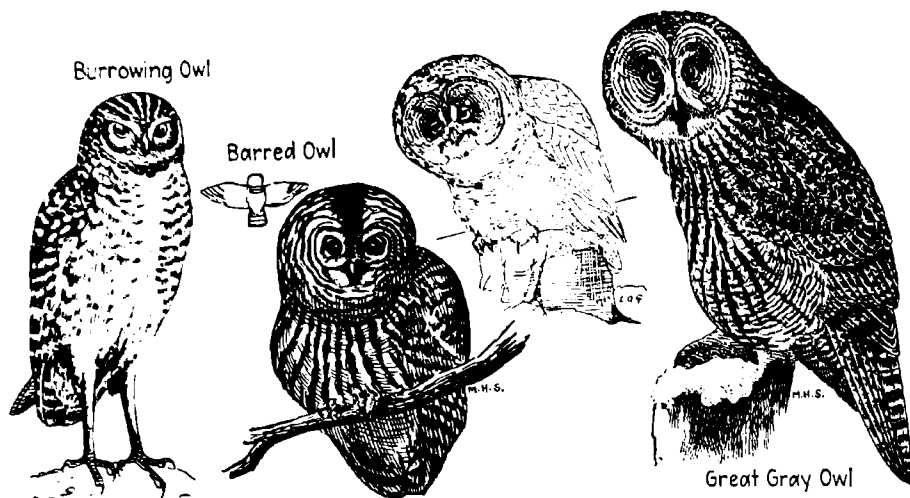
Length to 6 in., tail to 2 in., wing to 4 in. Shorter than pygmy owl, *Glaucidium gnoma*. Head without ear tufts. Eyebrows, cravat, and under parts white; interrupted white collar, and wings with whitish spots; otherwise, largely gray- or brown-speckled. Young more brownish-gray on top of head.

Elf owls range through southwestern United States and into Mexico; Sanford's, (California); Texas, (eastern) and Whitney's, (southwestern). Locally, may be abundant. Not migratory. Haunts low hot dry desert river bottoms and adjacent lands. Reported from Pleistocene of California.

Nests in holes up to 20 ft. high in saguaro cactus made by Gila woodpeckers or gilded flickers. In May, lays 3-5 pure white glossy granulated 1-in. eggs. These may hatch after 14 days' incubation into helpless young covered with white down. Molts: young, June-July; adults, September-October.

Food almost entirely grasshoppers and other insects, and centipedes; all caught at night when bird comes from its hiding place in hole or dense thicket. Call sounds like squeak of rubber toy. Males flock together during breeding season.

Probably entirely useful to man and to his interests. So unique that bird deserves protection at all times. When kept as a pet, refuses to eat other birds. This probably indicates that when free it is not a common bird killer. Is probably less savage than pygmy owl. Almost entirely dependent on giant cactus.



PHYLUM CHORDATA. CLASS AVES
Order Strigiformes. Family Strigidae. OWLS

Burrowing Owl, 378a

Speotyto cunicularia

Length to 11 in., tail $3\frac{1}{2}$ in., wing 7 in., bill $\frac{1}{2}$ in. Head without ear tufts. Legs long, nearly bare, and with bristly toes. Adults brown with white and buff spots and bars. Tail light-barred. Young with plain brown upper parts, plainer in general appearance, and with dark rather than white throat band.

2 subspecies recognized, the Western and the Florida. Western ranges from Pacific Coast of United States east to Minnesota and Louisiana, south to Panama; accidentally in Indiana, New York, and Massachusetts and migratory to Oregon. Florida found in central and southern Florida.

After interesting courtship of caresses, low song, and bows, nest is built of fine materials in burrow underground. Here are laid April-June, 6-11 smooth glossy eggs, 1 by $1\frac{1}{4}$ in. Incubation by both parents, about 3 weeks. 1 yearly brood. Young with scanty gray down. Plumage develops and begins to molt by July.

Food almost wholly insects and scorpions, with a few lizards, some small mammals and snakes, but principally grasshoppers. May live in prairie dog holes, but hardly cooperatively with hosts or with rattlesnakes which may also live there. Rattlesnakes alone could profit by such a relationship. May be active in daytime as well as at night.

Unquestionably almost wholly useful to man and should be protected. As man and his cars occupy a territory, these useful birds begin to disappear. Owl does not favor cultivated lands and so ranges are constantly decreasing. Long legs, bobbing movement, and short tail serve as good points of identification. Really splendid birds.

Barred Owl, 368

Strix varia

Length to 24 in., wingspread to 50 in., tail to 10 in., bill to $1\frac{1}{4}$ in. Weight to 2 lb. Female averages heavier than male. A large gray "earless" owl, with bars appearing crosswise on breast and streaked lengthwise on belly. Eyes large and brown. Feathers loose and fluffy.

3 subspecies recognized, Northern, Florida, and Texas. The Northern breeds from northern Saskatchewan to Newfoundland and south to Arkansas and Georgia. Found in fossil form in Pleistocene of Florida.

Nests usually in dense woodlands or wooded swamps in tall timber. Nest in hollow tree or in rebuilt nest of crow or hawk. Eggs 2-4, white, somewhat glossy and slightly rough, 2 by $1\frac{1}{4}$ in.; laid in late February. Incubation to 28 days, probably chiefly by female. 1 annual brood. Young white and downy when hatched.

Food chiefly mice and other rodents. Of 109 stomachs, contents were 48 with mice, 18 with other mammals, 20 empty, 9 with crawfish, 7 with small owls, 5 with other small birds, 14 with insects, 4 with frogs, 4 with game birds or poultry, including 1 ruffed grouse.

Economically beneficial in spite of fact that it may catch chickens forced to roost in trees at night. Obvious preference for mice indicates its primary service to man, which is not always appreciated. A barred owl calling in vicinity of a summer camp has made a vacation memorable to many youngsters.

Great Gray Owl, 375

Strix nebulosa

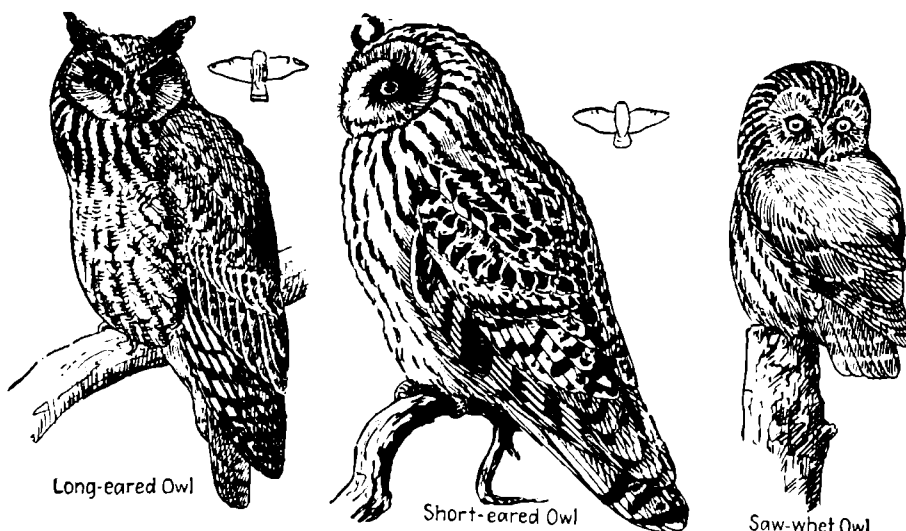
Length to 33 in., wingspread to 60 in., tail to 15 in., bill to $1\frac{3}{4}$ in. Weight to 2 lb. 14 oz. Largest of owls. Marked much like barred owl, but with no conspicuous cross bandings on breast and with eyes yellow rather than brown. No ear tufts. Size and round head usually sufficient identification.

2 subspecies are Great and Siberian. Latter ranges through eastern Siberia and is occasionally found in western Alaska. Great breeds from north central Alaska tree limit to Ontario and south to central California. Winters through southern Canada south to New Jersey.

Nests usually over 20 ft. up, in tall tree. Nest is old nest of hawk, lined or unlined. Eggs 3-5, white, smooth, $2\frac{1}{4}$ by $1\frac{1}{4}$ in. Incubation by female, for unknown time. 1 annual brood. Young downy and helpless when hatched, white, but darker later across upper parts. Young hatched in April appear like adults by October.

Food consists largely of mice, rabbits, and small birds, but detailed information such as is available for most other owls is lacking for this species. Examination of 9 stomachs showed 7 with mice, 4 with other mammals, 1 with a small bird. This inconclusive evidence indicates that probably bird is useful.

General statement issued from United States Department of Agriculture that owls are most beneficial of all birds probably applies to this species. Gray owl is hardly aggressive type represented by great horned owl. Rather it is considered unusually meek and by some persons, even stupid.



Long-eared Owl

Short-eared Owl

Saw-whet Owl

PHYLUM CHORDATA. CLASS AVES
Order Strigiformes. Family Strigidae. OWLS

Long-eared Owl, 366

Asio otus

Length to 16 in., wingspread to 42 in., tail to $6\frac{1}{2}$ in., bill to $1\frac{1}{10}$ in. Eye yellow. Appears about size of a crow, or like a small great horned owl with lengthwise streaks rather than crossbars. Grayer than short-eared owl, which it otherwise resembles in flight. Weight 11 oz., female the larger. Temperature, 103°F .

Breeds from central British Columbia to Newfoundland and south to southern California, northern Texas, and Virginia. Winters from southern Canada to Florida and central Mexico. Found in California Pleistocene. Prefers evergreen forests but may live anywhere, particularly in migration. Rarely seen doing daylight hunting.

Nests usually in a cone-bearing tree, from 10–30 ft. up. Nest usually remodeled nest of heron or crow. Eggs 3–7, weight, $\frac{1}{5}$ oz.; white and smooth, $1\frac{3}{4}$ by $1\frac{1}{2}$ in.; laid on alternate days but incubation begins with laying of first. Incubation 21–30 days. Young in nest 25 days. 1 annual brood.

Food almost exclusively mice and other small mammals. Stomachs of 23 examined showed 22 with mice and the other with a small bird. Of 107 examined, 84 contained mice, and 15 small birds. Excess and waste are regurgitated as pellets, of which 187 of 225 examined contained small mammals, mostly mice.

One of best of all mouse-catching owls. Therefore worthy of every protection. It is undoubtedly killed by many hunters carrying on vermin campaigns under the impression that it is a great horned owl. Partly because of this, such campaigns are generally wholly ill-advised.

Short-eared Owl, 367

Asio flammeus

Length to 17 in., wingspread to 44 in., tail to $6\frac{3}{5}$ in., bill to $1\frac{1}{4}$ in. Weight: female 13 oz., male $17\frac{1}{2}$ oz. Slightly smaller than crow, with shorter "horns" than long-eared owl; generally lighter and more yellowish. Chiefly white underside, wings and tail dark.

Breeds from northern Alaska to Greenland and south to California and New Jersey; also in Europe and Asia. Winters from British Columbia to Massachusetts and south to Cuba and Guatemala. Known from Pleistocene of California. Roosts on ground, usually in open country, and often active in daytime as it flies with steady beating flight.

Nests on ground, in open, merely by tramping down vegetation or bringing in a few sticks. Eggs 4–7, white or creamy, smooth, $1\frac{1}{4}$ by $1\frac{1}{4}$ in., laid May–June. Incubation believed to be 3 weeks, and mainly by female. 1 brood commonly, but possibly 2 as is case in Europe.

Food: 101 stomachs showed 77 with mice, 11 with small birds, 7 with moles or shrews, 7 with insects, 14 empty. One stomach had 30 huge grasshoppers in it. It usually prefers territory with an abundance of mice, and where there is such infestation short-eared owls may be expected to move in.

Essentially useful as a mouse check. Because of its daytime activity, it is frequently killed by ill-advised hunters carrying on foolish vermin campaign sponsored by many groups. Farmers should prosecute anyone killing this important friend of their interests. Call a *toot*, *toot*, *toot* and high-pitched shrieks.

Saw-whet Owl, 372

Aegolius acadica

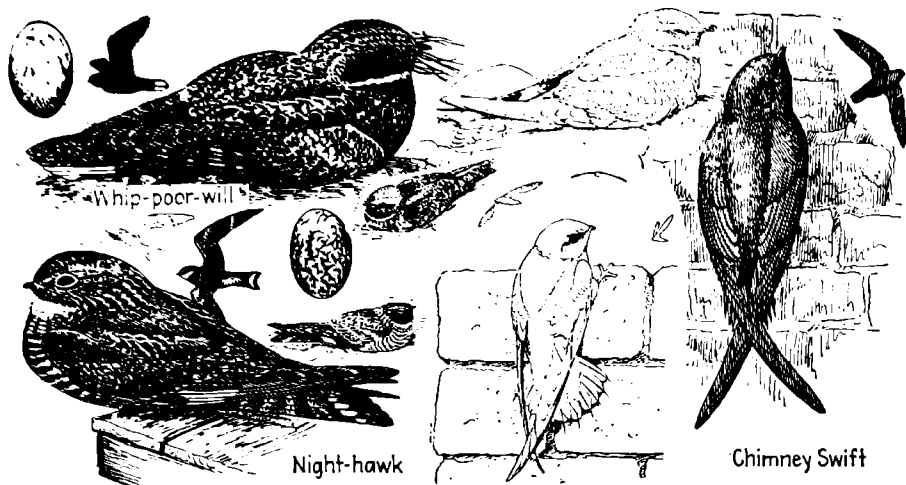
Length to $8\frac{1}{2}$ in., wingspread to $20\frac{1}{2}$ in., tail to $3\frac{1}{4}$ in. Sexes apparently same, female possibly somewhat larger. Temperature, 101°F . Looks like a small screech owl, without its characteristic ear tufts. Because of its size, not easily confused with other owls of its range.

Breeds from southern Asia to Nova Scotia, New Brunswick, and south to central California, Arizona, and Maryland. Winters south to southern California and Virginia and in southern part of its breeding range. Not often seen even when abundant, because of retiring and strictly nocturnal habits.

Nests in wooded areas, particularly where it is swampy. Nest in hole in tree, such as a deserted flicker hole. Eggs 3–7, chalky white, 1 by $\frac{9}{10}$ in. Incubation 21 days, by female. 1 annual brood. Young scantily covered with a whitish down, but by September usually has assumed adult plumage and whitish face.

Food: stomachs of 22 showed 17 with mice, 2 empty, 1 with a sparrow, and 1 with an insect. Of 7 stomachs taken in summer and autumn by another observer, 6 contained insects only and 1 contained a mouse, so bird food may be taken only when mice and insects are not available.

Obviously useful as mouse destroyer though never present in sufficient numbers to serve important role. In winter, numbers may appear greater than normal because of crowding where food is available. Call sounds like squeaks of filing a saw and young sound like a dog sniffing.



PHYLUM CHORDATA. CLASS AVES
Order *Caprimulgiformes*
Family *Caprimulgidae*

Whippoorwill, 417
Caprimulgus vociferus

Length to 10½ in., wingspread to 19½ in., tail to 5 in. Weight 2 oz. Female usually smaller than male. Feet small and weak. Perches on ground or lengthwise on a limb. Female appears all brown. Male in flight shows 2 white patches, about half length of tail, but no white wing patches; narrow white throat streak.

Breeds from Manitoba to Nova Scotia and south to northern Louisiana and northwestern South Carolina. Winters from South Carolina west through Gulf States and south to British Honduras, Salvador, and Costa Rica. In wooded areas favors mixed growth of hardwood and conifers.

No nest. Eggs laid on ground; 2, white or glossy, blotched; 1½ by ¾ in. Incubation 17-19 days, probably by female but male is reported to assist. Young with buff or yellow-brown down.

Food entirely insects, usually caught on wing, though not all are necessarily injurious. Insects eaten include June beetles, potato beetles, curworms, mosquitoes, ants, gnats, and practically all large moths that fly at night. Insect eggs have also been found though these must have been taken while not flying.

One bird was reported to have 36 moths in its stomach at one time. Whippoorwill's record as an insect destroyer is enviable and there is no reason why bird should be killed. To those who care for its haunts, its calls are most welcome even though they may annoy persons not used to hearing them.

Nighthawk, 420
Chordeiles minor

Length to 10 in., wingspread to 23¾ in., tail to 4¾ in. Female smaller than male. In flight, wing shows decided angle at middle and a conspicuous crossband near tip. Tail shows 2 narrow white crossbands and male's throat is conspicuously white. Marvelous erratic flight, high in air.

7 subspecies recognized include the Eastern, the Florida, the Western, the Pacific, the Howell's, the Cherrie's, and the Sennett's, with 2 subspecies of a closely related form. Most of United States and southern Canada covered by these forms. Winter range from Colombia to Argentina.

No nest built. Instead, eggs are laid on open ground, on graveled roofs in cities, in open spaces in fields, on roads, and elsewhere. Eggs 2, variable in markings; 1½ by ¾ in.; ¾ oz. Incubation 16-19 days, by both sexes. Bird weight 4 oz. Temperature, 104°F.

Food entirely insects, caught on wing, either day or night. Stomach of one nighthawk contained 1,800 winged ants, another, 60 grasshoppers; another 500 mosquitoes; and still another, a solid mass of glowing fireflies. Other records include potato beetles, cotton boll weevils, and other insects. Speed, 22 m.p.h.

Known also as a "bull bat"; was formerly shot in great numbers in migration because of skill required in hitting such an erratic target. Now protected by Federal laws, which should be enforced at all times since bird is so interesting and so genuinely valuable.

Order *Micropodiformes*
Family *Micropodidae*

Chimney Swift, 423
Chaetura pelagica

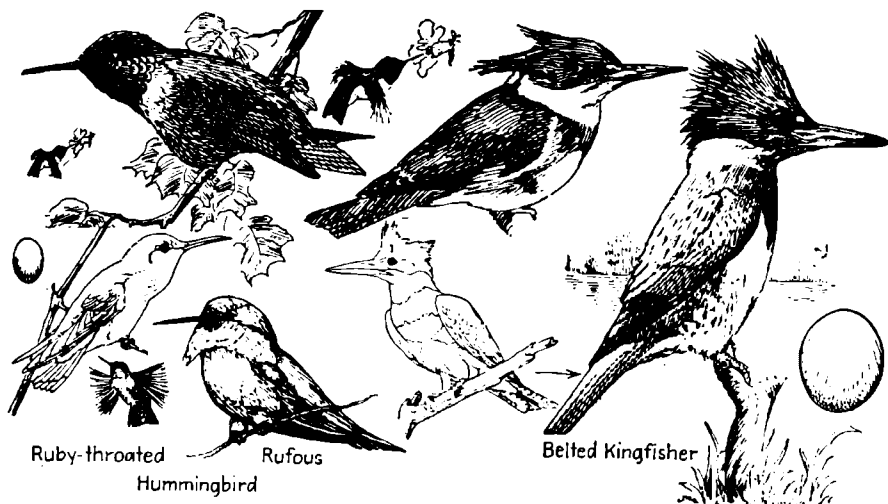
Length to 5¾ in., wingspread to 12¾ in., tail to 2 in. Female smaller than male. Tail conspicuous because of stiff bristle-like feather tips. In flight, resemble "flying cigars." Wings sometimes used alternately and rapidly to assist in darting flight necessary for food getting. General color sooty. Eyes large.

Breeds from central Alberta to Newfoundland and south to Florida, Gulf States, and eastern Texas. Winters at headwaters of the Amazon in western Brazil and eastern Peru. Accidental in Greenland and Bermuda.

Nests in hollow trees, or more commonly now in chimneys. Nest of sticks glued to chimney wall by a mucilage secreted by bird. Nest like a tiny basket, usually at least 20 ft. up. Eggs 4-6, white and moderately glossy, ¾ by ½ in. Incubation by both sexes, 18-22 days, at temperature of 111°F.(?).

Food exclusively insects caught in flight. When weather conditions are such that flying insects are kept from air any considerable time, swifts sometimes die by thousands. Call a typical twitter, welcomed by those who know it. Flight speed, 68 m.p.h.

Entirely valuable. Rumor that they carry bedbugs which may annoy man is without basis in fact. Big bedbugs found in nests of swifts cannot live away from them. Worthy of more protection than they get. Illegal now to kill them at any time. "Bird's-nest soup" made from nest of related Asiatic species. Mucus of nest, mostly dried saliva, is soup basis.



PHYLUM CHORDATA. CLASS AVES
Order Micropodiformes
Family Trochilidae

Order Coraciiformes
Family Alcedinidae

Ruby-throated Hummingbird, 428
Archilochus colubris

Length to 4 in., wingspread to $4\frac{3}{4}$ in., tail to $1\frac{1}{4}$ in., bill to $\frac{1}{2}$ in. Female sometimes larger than male. Male with beautiful changeable ruby or black throat, forked tail. Female, tail not forked, and color not so brilliant; 3 outer tail feathers white-tipped. Young generally like female.

Breeds from Alberta to Cape Breton Island and south to Texas, Gulf Coast, and Florida. Winters from middle Florida to Louisiana and southern Mexico to Central America and Panama. In migration, often flies across Gulf of Mexico, a prodigious effort for so small a bird.

Nest a tiny lichen-covered cup, about $1\frac{1}{2}$ in. across from outer limits and about $1\frac{1}{4}$ in. deep, down-lined, fastened to branch 3-30 ft. above ground. Eggs 2, white, $\frac{9}{16}$ by $\frac{3}{8}$ in. Incubation for 14 days, by female. 1-2 annual broods. Young fed by vigorous pumping of food from stomach of adult.

Food, nectar and insects and other small creatures which haunt throats of flowers. Can remain suspended before a flower and, unlike other birds, can fly backward. Fight vigorously among their own kind or attack birds and other animals many times their size. Rapid motion of wings responsible for name. Flight speed, 55 m.p.h.

Probably essentially useful, as some assist in pollination of certain deep-throated flowers, also destroying some insects which might be injurious to useful plants. Entirely harmless, intensely interesting as young and as adults, and therefore worthy of all possible protection.

Rufous Hummingbird, 433
Selasphorus rufus

Length: male to $3\frac{3}{4}$ in., tail $1\frac{1}{2}$ in.; female to $3\frac{1}{4}$ in., tail $1\frac{1}{4}$ in. Male with upper parts a bright red-brown and throat brilliant red; only hummingbird with a red-brown back. Female olive above, like most other female hummingbirds, but with some red on base of tail but not on rump.

Breeds from southern Yukon through British Columbia and southern Alberta to southern Oregon and southwestern Montana. Winters in southern Mexico; occurs in migration in Wyoming, eastern Colorado, and western Texas. Accidental in South Carolina. Other species in genus include broad-tailed and Allen's hummingbird.

Nests in bushes such as salal, and in ferns and dead trees bearing lichens. Nest of down covered with lichens, moss, and fine pieces of bark. Eggs 2, white. Male goes through elaborate courtship of aerial acrobatics, rising and falling and displaying before female.

Food, insects found on bushes and flowers and picked off while bird remains in flight. Among plants visited are wild currant, gooseberry, ocotillo, fireweed, paintbrush, agave, pentstemon, and gilia. This species, and particularly male of this species, is exceptionally pugnacious and fights for favored feeding area.

Delightful birds that are welcome in any flower garden for their beauty, vigor, and interesting habits. They may assist in pollination of some flowers and undoubtedly destroy some injurious insects.

Belted Kingfisher, 390
Megasceryle alcyon

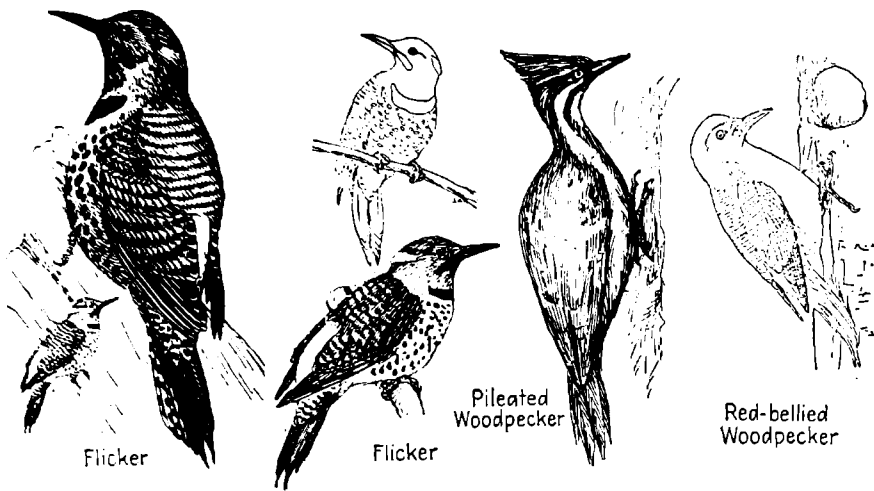
Length to $1\frac{1}{4}$ in., wingspread to 23 in., tail to 5 in., bill to $2\frac{1}{4}$ in. Weight to 6 oz., or as small as 4 oz. Sizes of sexes variable but more or less similar. Female with a broad, cinnamon-reddish band across lower breast, in addition to bluish band of male. Temperature, 101.1-108°F.

2 subspecies include the Eastern and the Western. Breeds from Alaska to Newfoundland and south to southern limits of United States. Winters from British Columbia to Virginia or even New York and south to Colombia, British Guiana, and Trinidad. Accidental, in Holland, Ireland, and Azores.

No nest. Eggs laid at end of burrow which is 4 in. across, from 3-15 ft. long, with enlarged room at end. Eggs 5-14, white, glossy, $1\frac{1}{2}$ by $1\frac{1}{8}$ in. Incubation for 16-17 days, chiefly by female, but possibly by both sexes. 1 brood a year in North, possibly 2 in South.

Food chiefly fish, but known also to include mice, frogs, lizards, insects, berries, newts, and crayfish. Insects eaten are chiefly larger water insects. General opinion of disinterested students is that kingfisher does more good than harm, unless it takes as its territory some place like a fish hatchery. Speed, 36 m.p.h.

Protected by law in some states. Whatever legal standing may be, it is hoped that no generations of young Americans grow up without many knowing the kingfisher's rattle.



PHYLUM CHORDATA. CLASS AVES
Order Piciformes. Family Picidae. WOODPECKERS

Flicker, 412a
Colaptes auratus

Length to 13 in., wingspread to 21½ in., tail to 4½ in., bill to 1½ in. Weight to 6 oz. In flight, conspicuous white rump patch and yellow under wings. All males and young female have black mustache patch behind bill and black neckband. Adult female without black mustache. *C. cafer*, red under wings.

2 subspecies of *C. auratus*, the Northern and the Southern. Breed from tree limit in Alaska to Nevada and east through Missouri, North Carolina, and Florida. Winter in southern part of breeding range, south to Gulf Coast. 4 subspecies of *C. cafer* extend range to Pacific Coast from Alaska to central Lower California, east to Missouri.

Nest built in hole in telephone pole or dead tree stub, a nesting box, or even in a building. Hole to 3 in. wide, 24 in. deep, and to 60 ft. up. Violent courtship antics. Eggs 3-20, white, highly glossy, 1½ by ¾ in., ¼ oz. Incubation by both sexes, 11-16 days. 1-2 annual broods. Male recognizes female by sight.

Food largely insects, particularly ants. One stomach contained 5,000 ants, and two others over 3,000 each. Other insects include grasshoppers, crickets, and beetles. Insects total about 61% of food, remainder being wild fruit, cherries, and weed seeds. Young molt to adult plumage June-October. Speed, 44 m.p.h.

Highly useful as insect destroyer, particularly of ants which foster crop-destroying aphids. Also one of few birds which destroys European corn borer which threatens Corn Belt. Known as highhole, yellowhammer, golden-winged woodpecker and (the Western) as red-shafted flicker. Alabama State bird. Birds fight others of own sex.

Pileated Woodpecker, 405a
Hylatomus pileatus

Length to 19½ in. Wingspread to 30 in. Weight to 1 lb.; female smaller than male. Dark-brown to black, showing flashing white in flight and conspicuous red crest. In female, forehead and fore part of crown are grayish-brown, and line along jaw is blackish rather than red. About size of a crow.

Northern species is resident from central Mackenzie to New Brunswick and Nova Scotia and south through Minnesota, Iowa, Illinois, Indiana, Ohio, Pennsylvania, and south in the Appalachians. Southern, Florida, and Western subspecies extend range south and west through Florida, California, and British Columbia.

Nests in hole in large tree, usually 12-60 ft. above ground, a cavity 12-30 in. deep, with 3-4 in. entrance, chip-lined. Eggs 3-6, 1½ by 1 in.; white, very glossy. Incubation by both sexes, 18 days, with most nesting in May. Young naked when hatched, developing plumage in nest. Adults molt in early fall or late summer but no spring molt evident.

Flight usually undulating or swooping. Digs huge rectangular holes in dead or living trees in search of carpenter ants that make up major portion of food. May also eat caterpillars, cockroaches, and other insects or rarely berries and even wild cherries. The call is a loud commanding *kuk-kuk, kuk-kuk*, like a very loud flicker but commonly rising at beginning.

Undoubtedly useful because it eats wood-destroying insects. Not known to injure common orchard trees. Its nests, when abandoned, are used by wood ducks and other birds and mammals unable to make such nests themselves. Expresses spirit of wild woodlands and deserves every protection.

Red-bellied Woodpecker, 409
Centurus carolinus

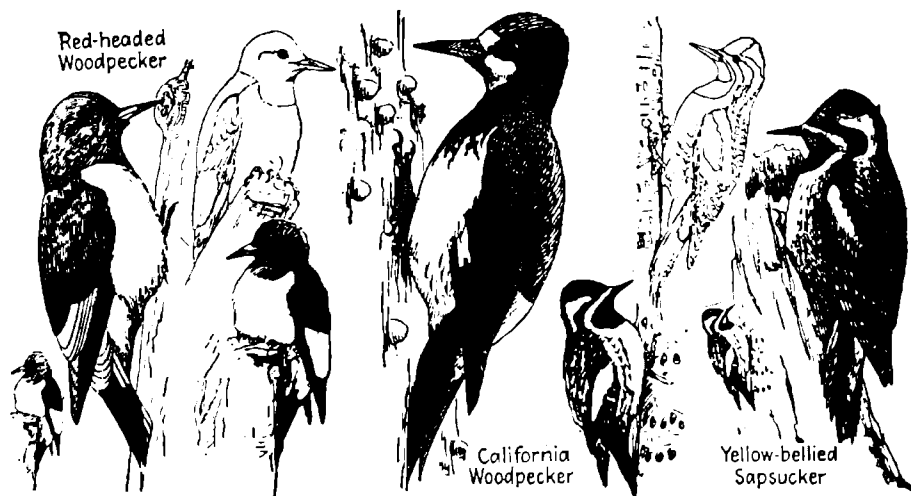
Length to 10¾ in. Wingspread to 18 in. Female smaller than male. Male conspicuously dark-striped on back, crown and nape red, breast, throat, and cheeks pale brown. Female like male, except that red on head is confined to nape and is replaced on crown by grayish-brown.

Resident of eastern United States from southeastern South Dakota through southwestern Ontario to western New York and occasionally into western New England and south to central Texas and Florida. Closely related to the golden-fronted, the gila, the cardon, and the Brewster's woodpeckers, which extend range to south and west.

Nests May-June, in hole dug in tree or pole 16-50 ft. above ground, with 1¾-in. entrance and depth to 12 in. Eggs 3-5 or more, 1 by ¾ in.; dull white. Incubated 14 days, by both sexes. Young helpless when hatched. Young of both sexes resemble female first winter, though some males may approach redness of adult male on head.

Essentially a bird of forests and shade trees of smaller communities. Shy and suspicious. Food primarily insects including caterpillars, beetles, and bugs but also including sometimes corn and other fruits. It may feed on sap of some trees, much like sapsuckers.

May injure fruits such as oranges in southern portion of range but usually is useful as a diligent destroyer of insect enemies of forest, fruit, and shade trees. Ordinarily it deserves protection.



PHYLUM CHORDATA. CLASS AVES
Order Piciformes. Family Picidae. WOODPECKERS

Redheaded Woodpecker, 406

Melanerpes erythrocephalus

Length to 9 $\frac{3}{4}$ in., wingspread to 18 in., bill to 1 $\frac{1}{8}$ in., tail to 3 $\frac{3}{4}$ in. Female generally smaller than male. Head and neck of adults red; in flight appears like black and white woodpecker with red head and large square white wing patches. Young head gray, not red. Weight 2 $\frac{3}{8}$ oz. Temperature 107.2°F.

Range from southeastern British Columbia to southeastern Ontario and south to New Mexico, central Texas, and Florida. Irregular in occurrence, found in Quebec, New Brunswick, Nova Scotia, Utah, and Arizona. Numbers have been greatly reduced over most of range.

Nest a hole in a telephone pole, hollow tree, or even tall fence post, with 1 $\frac{3}{4}$ -in. entrance, and depth to 18 in., chip-lined. Eggs white, slightly glossy, 4-6, 1 $\frac{1}{8}$ by $\frac{9}{10}$ in. Incubation 14 days, by both sexes. Annual broods 1-2. Young lose brown on head after first fall or winter. Complete fall molt; partial spring molt.

Food about $\frac{1}{3}$ animal matter, largely May beetles, grasshoppers, ants, and weevils, often caught in flight; sometimes these are stored. Eats eggs of other birds, rarely. May eat corn, pears, apples, cherries, grapes, and other fruits. Known to kill young chickens. Particularly favors beechnuts and acorns.

Probably more useful than injurious in spite of above record which emphasizes weaknesses rather than worth. Popular with children because of beauty; with schoolteachers, because name is easy to remember and children may paint its picture easily. Habit of flying from telephone pole to catch insects in air over high-speed roads may be fatal to species.

California Woodpecker, 407a

Balanosphyra formicivora

Length to 9 in., wing to 5 $\frac{3}{4}$ in., tail to 3 $\frac{1}{2}$ in. Female slightly smaller than male. A squarish white or yellow patch next to red crown. Upper parts glossy greenish-black. Female has black band separating white of forehead from red of crown. When in flight, appears black and white, with large white rump and wing patches. Markings indistinct in young.

5 subspecies recognized to include the Anteater, the Mearns, the California, the San Pedro, and the Narrow-fronted woodpeckers. Range covers southwestern United States from Oregon to Texas and, with some subspecies, south through Mexico, with related species into northern South America.

Nests usually in a hole in white oaks, but also in pines, cottonwoods, black oaks, and other trees. Hole usually 6-18 ft. from ground. Eggs 4 to rarely 6; white, with little gloss, 1 by $\frac{5}{8}$ in. Incubation by both parents, 14 days. Sometimes, 2 pairs use same nest. Young blind when hatched. Juvenile feathers molted second fall.

Food chiefly acorns, rarely fruit and sap. Acorns are stored without being opened by being driven into holes in outside of trees, often sufficiently to cover wide area. Sometimes as many as 1,500 acorns stored on one telephone pole. Feet not used for holding food.

Probably not important economically. Rare cases of eating eggs of other birds, frequent cases of mutilating trees, and wholesale cases of destroying acorns not to bird's credit. Rumor that only injured acorns are eaten is not well founded.

Yellow-bellied Sapsucker, 402

Sphyrapicus varius

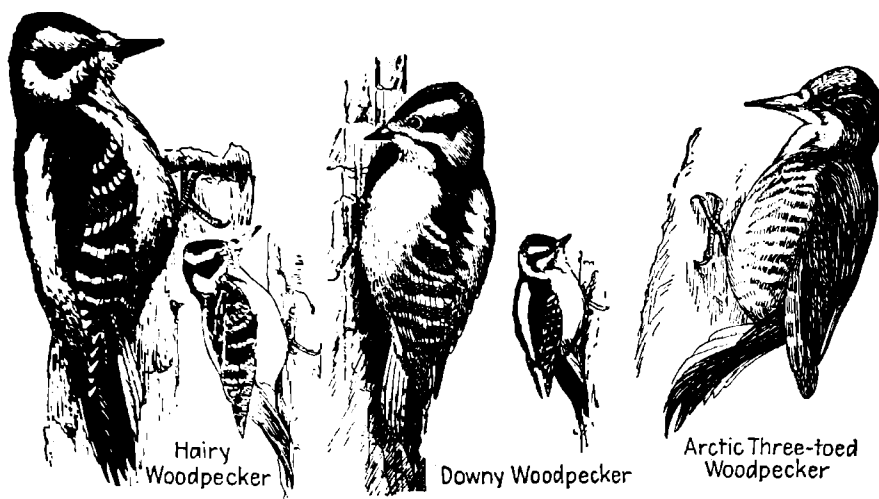
Length to 8 $\frac{3}{4}$ in., wingspread to 16 in., tail to 3 $\frac{1}{4}$ in. Weight 1 $\frac{3}{4}$ oz. Temperature 108°F. In field, appears in flight with a longitudinal white patch on each black wing. A red crown patch. Male with red throat, female with white. Young birds appear as adult after first winter.

4 subspecies include the Yellow-bellied, the Red-naped, the Northern Red-breasted, and the Southern sapsucker. *S. varius* breeds from central Mackenzie to Cape Breton Island and south to Missouri and northern Massachusetts. Winters from Iowa to Massachusetts and south to Panama. 1 closely related species.

Nests in coniferous or mixed forests, open farm land, or marshes. Both sexes dig 1 $\frac{3}{4}$ -in. hole, 18 in. deep, 12-10 ft. above ground. Eggs 5-7, white, slightly glossy, $\frac{9}{10}$ by $\frac{2}{3}$ in. Incubation for 14 days, by both sexes. 1 annual brood, young being reared by both parents.

May cause serious damage to useful trees by girdling them with their drillings. Drillings are orderly and close, and attract squirrels, chipmunks, insects, hummingbirds, and other creatures to feast. May visit a series of trees in a regular round. Fortunately, bird is not common. Drumming is an interrupted staccato.

Damage caused to trees may total $\frac{1}{4}$ million dollars a year according to Federal government. Numbers are so few that, except locally, control is rarely practiced.



PHYLUM CHORDATA. CLASS AVES
Order Piciformes. Family Picidae. WOODPECKERS

Hairy Woodpecker, 393

Dryocopus villosus

Length to $10\frac{1}{2}$ in., wingspread to $17\frac{1}{2}$ in., tail to 4 in., bill to $1\frac{1}{3}$ in. Weight to 3 oz. Temperature, 105°F . Female smaller and lacks red on back of head. Outer tail feathers white, without black bars or markings. Works on trunks and branches of trees, head uppermost.

Subspecies 13, including in their resident range territory from Alaska to Newfoundland within tree zone and south into northern Mexico and through Florida. Included are the Northern, the Eastern, the Southern, the Rocky Mountain, the Lower California, the Sitka, and the Newfoundland hairy woodpeckers whose ranges are significant. Orchard and woodland species.

Nests in woods and orchards. Nest hole in a dead branch or tree trunk. Entrance 2 in., depth to 16 in., 5-50 ft. above ground. Eggs 3-5, shining white, $1\frac{1}{2}$ by $\frac{3}{4}$ in. Incubation 14 days, by both parents. 1 annual brood. Young soon similar to adults.

Food, insects gleaned from bark or dug from dead wood. Most destructive of hairy caterpillars and of their chrysalids, including pestiferous gypsy moth, within its range. Also eats ants, grasshoppers, spiders, and wood-boring beetles. Estimated 77.7% of food is animal matter, remainder vegetable, including nuts and seeds.

Entirely useful and most valuable about orchards. Good orchard practice calls for erection of nest sites or protection of existing sites. Individual range only a few acres if food and nesting sites are available in sufficient abundance.

Downy Woodpecker, 394c

Dryocopus pubescens

Length $7\frac{1}{2}$ in., wingspread $12\frac{1}{4}$ in., bill $\frac{3}{5}$ in. Weight $1\frac{1}{2}$ oz. Black and white streaked, with white outer tail feathers barred faintly or marked with black spots. Male with red spot on back of head, which is lacking in female. Southern downy woodpecker, browner on under parts than Northern. Temperature, 108°F .

Mostly resident. 6 subspecies include the Northern and the Southern, which range from southern Alaska to Newfoundland within tree belt and south to California, Arizona, and Gulf States. Northern is rarely south of Nebraska and Virginia. Rarely above 3,000-ft. altitude. Tree species.

Nests in orchards, mixed forests, and shade trees. Hole in a grape trellis or tree. Entrance $1\frac{1}{4}$ in., depth to 10 in. Eggs 4 to rarely 8, white, $\frac{3}{4}$ by $\frac{3}{4}$ in. Incubation about 12 days, by both sexes. Young reared by both sexes. 1 annual brood.

Food: examination of stomachs of 723 birds showed 76% animal matter, mostly insects which are plant pests. Vegetable matter included sap and cambium of trees and seeds of plants. Food gleaned from trunks and limbs of trees or dug from wood.

Undoubtedly useful. While it may eat some of growing layer of trees and drink sap, injury in these activities is minor and is scattered rather than concentrated in one area as with sapsuckers. Easily attracted to feeding stations by suet and become unusually popular window visitors.

Arctic Three-toed Woodpecker, 400

Picoides arcticus

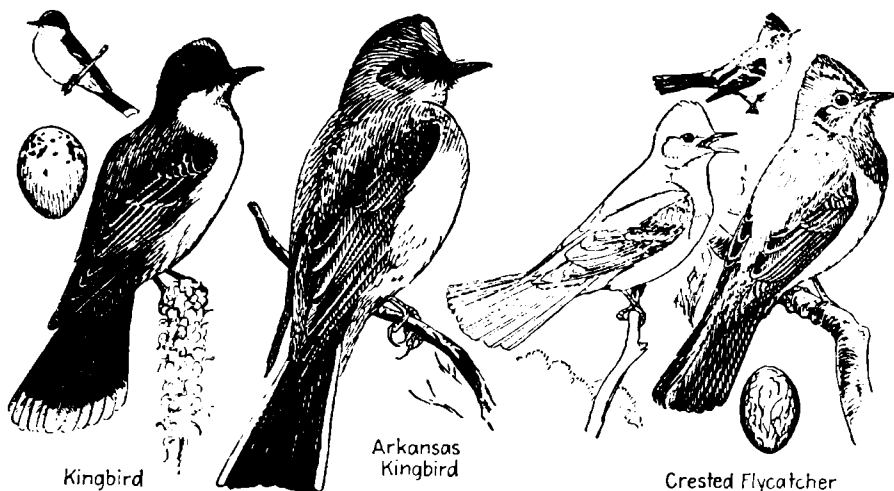
Length to $10\frac{1}{2}$ in. Wingspread to 16 in. Male with a yellow crown patch which is lacking in female. Otherwise, both sexes essentially solid black on back, white on breast, with narrow transverse black and white stripes on sides. Bill about as long as head. Feet with 2 toes in front and 1 behind, fourth lacking.

Breeds from central Alaska in Yukon region to northern Quebec and south to central California, Minnesota, New York, and New England, with winter range occasionally a little farther south to include Pennsylvania, New Jersey, Ohio, Indiana, and Illinois. Commonest in dense evergreen forests.

Nests in evergreen forest, in a hole with a diameter of to 2 in., to 18 in. deep, widened at base and lined with chips. Eggs usually 4-6, $1\frac{1}{2}$ by $\frac{1}{2}$ in.; white, moderately glossy. Nesting period late May and June. Incubation by both sexes, 14 days. 1 annual brood. Young helpless when hatched. Noisy in breeding time.

Food about 75% insects and remainder nuts, wild fruits, and soft inner bark of trees. Seems to listen for movement of insects inside tree before drilling hole for capture. Works almost exclusively on dead trees, seeking out pests that breed in them and often working extensively on a single tree.

It probably is useful as a check on wood-destroying insects. Its migrations are usually definitely associated with disappearance of dead timber or a reduction in insect population due to various causes. Estimated that one bird may destroy 13,000 wood-boring grubs in a year.



Kingbird

Arkansas
Kingbird

Crested Flycatcher

PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Tyrannidae. FLYCATCHERS

Kingbird, 444
Tyrannus tyrannus

Length to 9 in., wingspread to 15 in., tail to $3\frac{3}{4}$ in., bill to $\frac{7}{8}$ in. Weight to 1 $\frac{3}{8}$ oz. Sexes about equal in size and coloration. General color slaty-black, with white under parts and white band at tip of broad fan-like tail. Orange-red crown patch, which is larger in male than in female, not easily seen.

Breeds from Southern British Columbia to Nova Scotia south to central Nevada, northern New Mexico, southeastern Texas, and southern Florida. Winters from southern Mexico to Colombia, Peru, British Guiana, and Bolivia. Occasionally in Cuba and Greenland. Ordinarily rests on high exposed perch from which it catches food in open air.

Nests in orchards and at woodland borders. Nest ragged outside but well made inside, from 3-20 ft. above ground. Eggs 3-5, larger end marked with brown, purple-brown, or lavender spots, $1\frac{1}{8}$ by $\frac{3}{4}$ in.; weight $\frac{1}{8}$ oz. Incubation chiefly by female, for 12-13 days. 1-2 annual broods. Temperature, 105-110°F.

Food essentially insects. In 665 stomachs examined, honeybees were found in 22, total number of bees being 61, of which 51 were drones, 8 workers, and 2 undetermined. 26 robber flies, enemies of honeybees, were found in 19 stomachs. It is estimated that one robber fly may kill many bees a day. Song, 5,850-6,225 c.p.s. Speed, 23 m.p.h.

Unquestionably, a friend of general farmer though individuals with nests near apiaries may be destructive to bees. The name bee martin is, on the whole, unfortunate. The kingbird drives hawks, eagles, herons, and crows from near its nesting site or from territory it has taken as its own.

Arkansas Kingbird, 447
Tyrannus verticalis

Length to $9\frac{1}{2}$ in., wingspread to $16\frac{1}{2}$ in., tail to 4 in. Female slightly smaller than male. In this species, white on sides instead of tip of tail; upper parts are gray, lower parts yellow, so there should be no misidentification. Crown patch on female is smaller than that on male, as in eastern kingbird.

Breeds from southern British Columbia to Minnesota and south to northern Lower California, Chihuahua, and western Texas. Winters from western Mexico to Nicaragua. Occasionally found in Massachusetts, New York, Florida, Virginia, South Carolina, Maryland, Maine, Michigan, Wisconsin, and Illinois.

Nest placed on branch of tree like that of eastern kingbird, or on crossbars of telephone poles. Eggs 3-5; like those of eastern kingbird but slightly smaller, $\frac{9}{10}$ by $\frac{2}{3}$ in. Incubation by both sexes, for 12-13 days. Both parents assist in rearing and protection of young. 1-2 annual broods.

Food known to be 90% insects, remainder mostly wild fruits and seeds. Food is, for most part, caught on wing. Number of beneficial insects found in 109 stomachs was too small to have any significance. Speed, 18 m.p.h.

Species is undoubtedly one of most useful species of birds in its range. It is entitled to every possible protection from Federal, state, and private sources. Bird should be studied more in schools than seems to have been the case.

Crested Flycatcher, 452a
Myiarchus crinitus

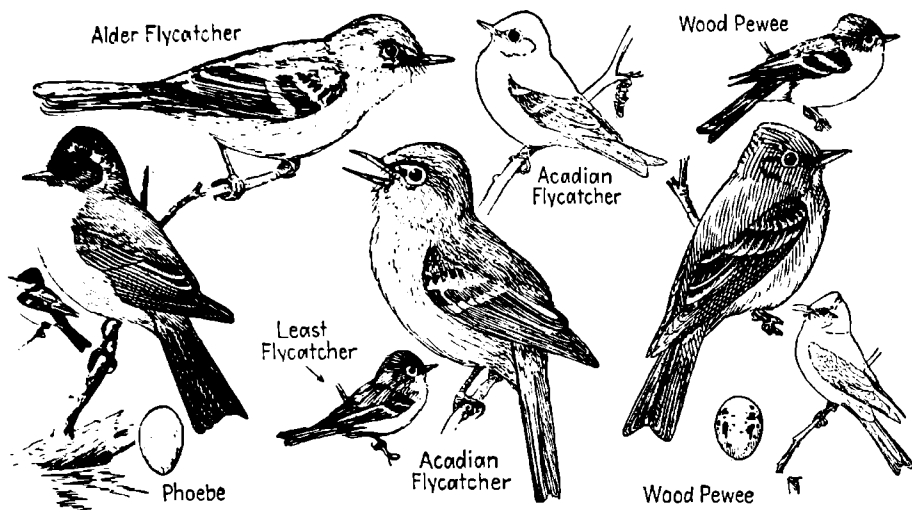
Length to $9\frac{1}{8}$ in., wingspread to 14 in., tail to $3\frac{1}{8}$ in. Female smaller than male. With conspicuously reddish (rufous) long, loosely hung tail, brown back, yellow belly, and gray throat and breast. Young by first winter practically indistinguishable from adults.

2 subspecies include the Northern and the Southern. Northern breeds from central Manitoba to New Brunswick and south to Texas and South Carolina. Winters from eastern and southern Mexico to Colombia. Southern breeds along Atlantic Coast, South Carolina to Florida, and winters from southern Florida to Central America.

Northern crested flycatcher courts by display and pursuit. Builds nest in deserted woodpecker hole, natural hollow, or bird box. Usually, nest has one or more cast snakeskins in it. Eggs 3-8, creamy to pinkish with marks or scratches of brown or black; 1 by $\frac{3}{8}$ in. Incubation 13-15 days, by both sexes. 1 or rarely 2 annual broods.

Food almost exclusively insects, caught on wing. Estimated that food is 94% animal matter. Insects include sawflies, stinkbugs, May beetles, strawberry weevils, cotton boll weevils, cicadas, grasshoppers, crickets, katydids, moths, and caterpillars. In 265 stomachs, only 1 with a honeybee.

Entirely useful to man's economy and most interesting. The *wheep* call in wooded areas from late spring to fall is enjoyed by every bird lover.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Tyrannidae. FLYCATCHERS

Phoebe, 456
Sayornis phoebe

Length to 7¼ in., wingspread to 11¼ in., tail to 3½ in. Weight ½ oz. Female smaller than male. No wing bars such as on wood pewee. Tail long, loosely hung, and active. Bill black and wings dark. In winter, adults more olive and under parts yellower than in spring; young, like adults in autumn. Temperature, 101–108.6°F.

Breeds from central Mackenzie to Prince Edward Island and south to northeastern New Mexico and highlands of Georgia. Winters in United States south 37°N.L. and on to Vera Cruz in Mexico. In migration, may appear in Cuba, California, Lower California, Wyoming, and Colorado.

Nest in a crevice, on a wall, in a gorge, under a bridge, on a porch, or in an abandoned building. Usually largely of mud covered with mosses, rather bulky but well lined. Eggs 3–8, usually unspotted, white or with a few scattered reddish or blackish spots, ¾ by ⅔ in. Incubation 12–16 days, by one or both sexes. Normally 2 broods a year, sometimes 3.

Food almost wholly insects such as destructive moths, cotton boll weevils, gypsy moths, brown-tail moths, corn leaf beetles, cucumber beetles, ants, grasshoppers, locusts, crickets, ticks, and caterpillars. Sometimes cleans pests from backs of cattle. Examination of 370 stomachs proved bird almost wholly helpful to man's interests.

Because of food habits, worthy of every protection. The whistled song of the chickadee is often confused with that of phoebe. Beloved by many people because of its habit of nesting about old country homes. Song, 3,300–5,200 c.p.s.

Flycatchers

1. *Empidonax virens* (Acadian), 465
2. *E. traillii* (alder), 466
3. *E. minimus* (least), 467

Length: (1) to 6¼ in.; (2) to 6 in.; (3) to 5¾ in. Wingspread: (1) to 9½ in.; (2) to 9 in.; (3) to 8½ in. (1) the greenest; (2) the brownest. (1) without white throat of (2) and (3). (3) with white eye ring and 2 white wing bars, grayer above and lighter beneath than the others.

Breeding range: (1) Nebraska to southeastern Ontario and south to Texas and Florida; (2) central Alaska to Newfoundland and south to British Columbia and Maryland; (3) central Mackenzie to Cape Breton Island and south to Montana and North Carolina. Winters (1) Colombia and Ecuador; (3) northeastern Mexico to Panama.

Nests: (1) partly suspended in fork of twigs, 4–20 ft. up; (2) rarely over 4 ft. up in low shrub; (3) usually 8–40 ft. up in shade tree. All compact nests, lined with finer materials, with usually 3–4 or sometimes 6 eggs. Eggs unspotted white, (1) ⅔ by ⅓ in.; (2) ⅔ by ⅓ in.; (3) ⅔ by ½ in. Incubation usually 12 days, probably by both sexes and 1 or rarely 2 annual broods.

(1) of mixed woodlands, call *peet* or *kareep*; (2) haunts thickets near small streams and waterways, calls *way-be-o*; (3) in orchards and open woodlands where it calls *chebec*. All are small flycatchers, catching their food on wing while flying up from an exposed perch for most part. They are easily confused but above notes may be useful in modifying a guess.

Useful as destroyers of insects in their chosen haunts and interesting to watch and hear, particularly on their spring migration and during breeding season. None has any harmful habits and so are worthy of protection for their good qualities.

Wood Pewee, 461
Contopus virens

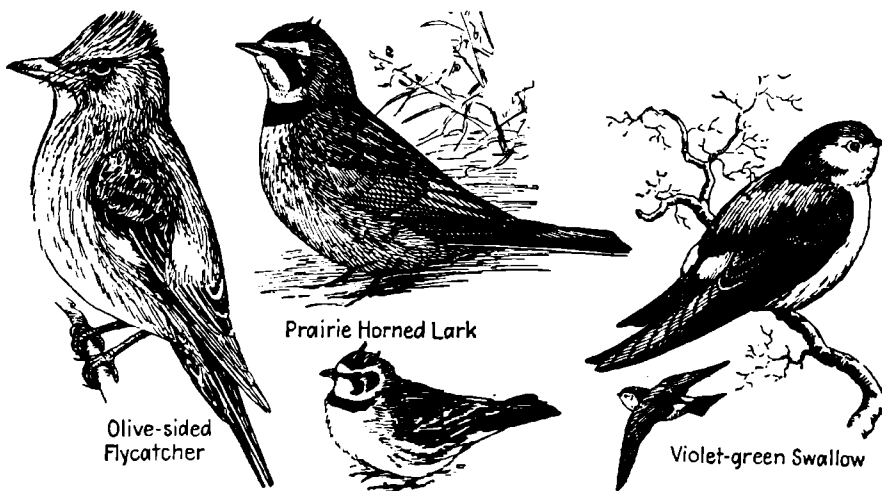
Length to 6¾ in., wingspread to 11 in., tail to 3 in., bill ¾ in. Female smaller than male. Conspicuous field marks are 2 light bars on each wing, and lower bill lightish in color. Young much like adults but with 2 distinct yellowish-brown wing bars, practically like adults by first winter.

Breeds from southern Manitoba to Prince Edward Island, south to central Texas and central Florida. Winters from Nicaragua to Colombia and Peru. Accidentally in Cuba. Occasionally in Colorado. 2 related wood pewees extend range to Alaska and West Coast down to Lower California for breeding range and farther for winter.

Nests common in woodlands or orchard or shade trees; nest built on horizontal limb, like a shallow saucer of rootlets and similar materials, often with lichens on outside. Eggs 2–4, white or creamy with spots and blotches of brown, lavender, or purple; ⅔ by ⅓ in. Incubation 12 days, chiefly or solely by female. 1–2 annual broods.

Food: by an examination of stomachs of 359 birds, shown to be 99% animal matter, chiefly small insects, including beetles, weevils, flies, moths, grasshoppers, crickets, bugs, and caterpillars of many sorts. The plaintive *peewee* call is associated with sleepy warm summer afternoons, not with strenuous city life.

Almost entirely useful to man's interests and certainly worthy of every protective effort which may be shown it. Known to catch small trout around fish hatcheries but this damage is negligible. Known to feed and rear abandoned young of other species of birds in other nests. Song, 3,650–4,375 c.p.s.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes

Family Tyrannidae

Olive-sided Flycatcher, 459
Nuttallornis borealis

Length to 8 in. Wingspread to 13 in. Female smaller than male. Dark olive on sides, with white on throat, down chest and belly, and between wings and body, last not always showing. Bill large. Back, head, most of wings and tail appear darker than rest of bird. Sexes similarly colored.

Breeds from central Alaska to southern Quebec and Cape Breton Island and south to northern Lower California, Texas, northern Michigan, New York, and in mountains south to North Carolina. Winters in northern South America in Colombia and Peru after migrating through Mexico. Accidental in Greenland.

Nests in open woods or clearing near woodlands. Nest on horizontal branch, usually of cone-bearing tree, 10-50 ft. above ground, shallow, of twigs, roots, and lichens with moss lining. Eggs, 3, $\frac{3}{10}$ by $\frac{2}{4}$ in.; cream to pinkish with chestnut, lavender, or purple spots and blotches at larger end. Incubation 14 days. 1 annual brood.

Usually perches at extreme tip of some exposed dead branch overlooking brushy land. Flies off into space, capturing food insects on wing. About 3% of food may be fruit. Large proportion of flying insects may be bees. Defends nest vigorously. Calls *tuck three beers* or *three cheers*. Females twitter much about nest.

Woodland species seldom near beehives where it might be destructive of useful bees but ordinarily exceptionally valuable as insect destroyer. Bird lovers enjoy spirited calls and behavior of olive-sided flycatcher and eagerly await its announced spring arrival. Southern migration begins in August as soon as young birds are able to fly well.

Family Alaudidae

Prairie Horned Lark, 474b
Eremophila alpestris

Length to $7\frac{3}{4}$ in., wingspread to $13\frac{1}{4}$ in., tail to $2\frac{3}{4}$ in. Horned lark, slightly larger and with yellow line over eyes instead of white line of prairie horned lark. Appears slightly smaller than robin but with contrasting light-colored body and black tail; walks, rather than hops. Tends to form flocks.

Prairie horned lark breeds from southern Manitoba to central Quebec and south to Missouri and Connecticut. Winters south to Texas and rarely to Florida. Related subspecies, 16; extend range over most of United States, Canada, Mexico, and Colombia; differences of minor importance. In California Pleistocene. Open field species.

Builds nest on ground, early in each spring. Nest of grass, lined with soft stuffs. Eggs 3-5, light drab or grayish, uniformly spotted with brown of different shades, 1 by $\frac{2}{4}$ in. Incubation for 11-14 days, by both sexes but chiefly by female. Annual broods 2, 3, or even 4 on rare occasions.

Food largely waste grain, weed seeds, and insects, particularly cutworms which may be exposed by plowing and cultivation activities. Especially good in winter as destroyer of weed seeds; follows farmers in fields getting insects as soon as they are turned to surface. Flight speed, 54 m.p.h.

Essentially a useful species. May do some damage to winter wheat if it is not covered properly or if it does not become established soon, but this damage is more than offset by good done. Apparently worthy of protection at all times.

Family Hirundinidae

Violet-green Swallow, 615
Tachycineta thalassina

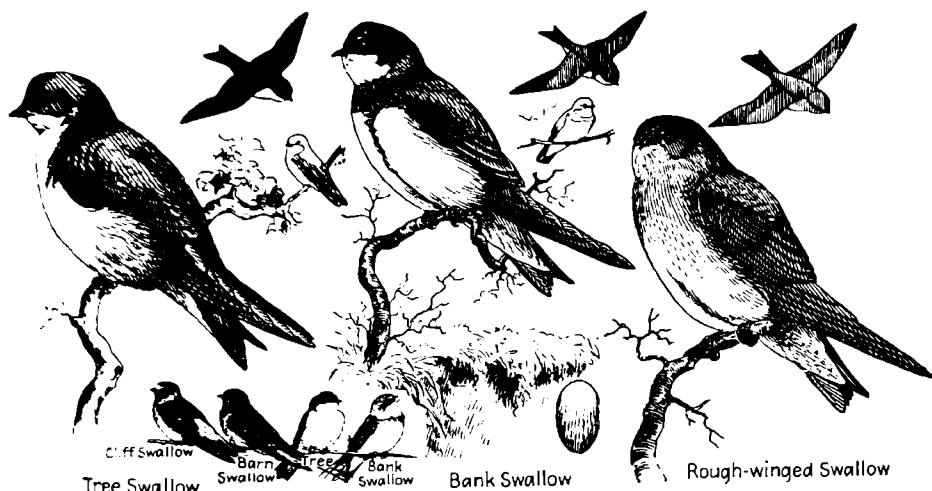
Length to 5 in., wing $4\frac{3}{4}$ in., tail 2 in., bill $\frac{1}{2}$ in. Female smaller than male, length, $4\frac{1}{2}$ in. Crown and head bronze-green to purple-bronze, wings green with purple tinge, upper tail purple, under parts white, tail and wings black with blue gloss. Female duller than male. Young sooty-brown above.

Breeds from central Alaska to central Alberta, south to northern Lower California and northern Durango, and east to western South Dakota and Nebraska. Winters in Mexico and south to Guatemala and Costa Rica, going through western Texas in migration. Accidental in Illinois.

Nests in cliffs, old woodpecker holes, and hollow trees. Nest with lining of grass and inner lining of feathers. Eggs white, 4-5. Incubation probably as with other swallows. In Oregon, violet-green swallows seem to take readily to nesting boxes. Not infrequently found in attics and abandoned houses.

Food practically 100% insects. Bugs make up $\frac{1}{4}$ of food, with leaf hoppers being an obvious favorite. Wasps and wild bees constitute $\frac{1}{6}$ of diet, beetles about $\frac{1}{10}$, and ants slightly less. Migration leisurely in fall but en masse in spring.

Few birds can equal or excel its beauty either while perched or when in flight and its food habits are exemplary so far as man's interests are concerned.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Hirundinidae. SWALLOWS

Tree Swallow, 614
Iridoprocne bicolor

Length to 6¼ in., wingspread to 13¼ in., tail to 2½ in., bill to ½ in. Female smaller than male. Easily identified by clear clean white under parts and steel blue- or greenish-black back. Young first winter, more grayish than blue above; throat not wholly a clear white. Temperature, 109.6°F.

Breeds from northwestern Alaska to northern Quebec and south to southern California and Virginia. Winters from central California to North Carolina, and south over Mexico, Cuba, and Honduras. Occasionally found in Bermuda during migration.

Usually in cultivated areas or over water. Nests in some tree cavity or bird box. Nest with a grass lining, with feathers provided in abundance. Eggs, 4-10, white to rosy, ⅜ by ⅝ in. Incubation for about 14 days, by both sexes. 2 broods may be raised in season. 2 females may occupy 1 nest.

Essentially an insect eater, eating many mosquitoes, robber flies, and ants. Eats more vegetal matter than most other swallows, favoring bayberries, blueberries, and fruits of red cedar and Virginia creeper. Probably only slightly less valuable than barn swallow.

Role as insect destroyer makes it unusually valuable in rural areas and in mosquito-infested regions. Comes readily to bird boxes erected near marshes and in wet places in public parks. By its beauty, grace in flight, and food habits adds to attractiveness of environment.

Bank Swallow, 616
Riparia riparia

Length 5½ in., wingspread 11½ in., tail 2½ in., bill ½ in. Female smaller than male. Winter plumage assumed after southern migration in fall. Distinctly brown-backed swallow, with conspicuous dark band across breast, which is lacking in rough-winged swallow, another brown-backed form.

Breeds from northern Alaska to northern Quebec south to southern California and Virginia; also in Europe, British Isles, Siberia, Tunisia, and Algeria. Winters through Mexico to Brazil and Peru, with allied races in India, East Africa, and South Africa. Not commonly found nesting near dwellings of man.

Nest near water in high bank, a room about 5 in. in diameter at end of a tunnel extending from 15 in. to 8 ft. back into bank. Lining of feathers and grass. Eggs 3-7, white with a rosy tinge, weight ½ oz. Incubation 12-13 days by both sexes. 1-2 annual broods.

Food essentially insects, with an obvious emphasis on flies and weevils. Cold rains, which keep flying insects down during time young are developing, are often fatal to great numbers of swallows and swifts. If food is not in air, birds do not get it. Speed, 31 m.p.h. Temperature, 102.6-112.4°F.

Possibly not so useful as other swallows because it is not found so commonly about man's dwellings, but it certainly is not harmful. Nest-building activity is always worth watching and sight of their flying into nest at feeding time is intriguing.

Rough-winged Swallow, 617
Stelgidopteryx ruficollis

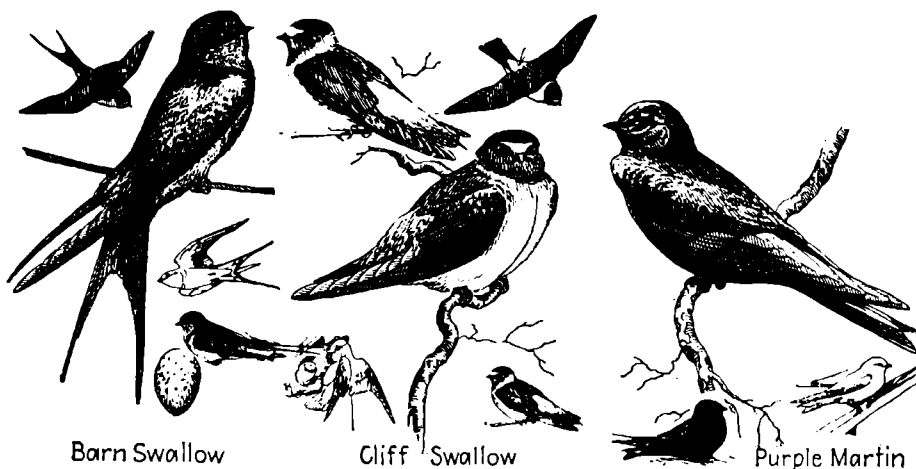
Length 5¾ in., wingspread 12¼ in., tail 2½ in., bill ½ in. Female smaller than male, otherwise sexes appear alike. Brown-backed, ordinary-looking swallow, with tail only slightly forked and without dark breast band which marks smaller and generally grayer backed bank swallow. Young like adults. Temperature, 108.7°F.

Breeds from southern British Columbia to southeastern Ontario, and south through United States to southern California, Vera Cruz in Mexico, and central Florida. Winters from southern Arizona and Mexico south to Costa Rica with associated races in Central America.

Nests usually a hole near water in a bank or cliff, under a bridge, in a building or hollow tree. Nest bulky, lined with grasses or pine needles, with few or no feathers. Eggs 4-8, glossy white, ¾ by ½ in. Incubation not commonly known, but probably only 1 brood of young a year.

Food like that of other swallows, almost exclusively insects caught on wing or by skimming close to surface. Mosquitoes and other aquatic insects probably figure high in diet. Not found about dwellings so commonly as barn swallow and cliff or cave swallow.

Has no habits contrary to man's best interests and so is worthy of protection wherever it establishes itself. Less friendly to man than cliff swallow, barn swallow, and purple martin.



Barn Swallow

Cliff Swallow

Purple Martin

PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Hirundinidae. SWALLOWS

Barn Swallow, 616
Hirundo rustica

Length to $7\frac{3}{4}$ in., wingspread to $13\frac{1}{2}$ in., tail to $4\frac{1}{2}$ in. Female smaller than male. Tail more deeply forked than any other associated swallow. Male, forehead chestnut, but elsewhere above glossy dark steel-blue, chestnut below on chin and throat but lighter to rear. Female similar but sometimes duller.

Breeds from northern Alaska to northern Quebec, south to southern California, northeastern Arkansas, and Virginia. Winters from central California, southern Texas, Gulf States, and South Atlantic States, south over Mexico, Cuba, and Honduras.

Usually in open country, in farm buildings, commonly not far from water. Nest usually directly under roof of barn, shed, or porch, of mud with lining of grasses and feathers. Eggs 3-6, white or whitish spotted with brown or purple, $1\frac{1}{16}$ by $\frac{3}{8}$ in.; egg weight $\frac{1}{20}$ oz. Incubation 11-13 days, mostly by female. 2-3 annual broods.

Food practically all animal matter, caught on wing. Much food caught close to surface of water. Fish sometimes catch swallows. Food includes mosquitoes and other flies, bees, wasps, but practically no honeybees; moths of cutworms, codling moths, and weevils. Sometimes gullet is packed to twice normal size. Speed, to 46 m.p.h.

Injures none of man's interests and helps in many ways. Living near a house, it kills great numbers of houseflies, mosquitoes, horseflies, and similar pests of man and his domestic beasts. Entitled not only to protection but encouragement through safeguarding of nesting sites.

Cliff Swallow, 612
Petrochelidon pyrrhonota

Length to 6 in., wingspread to $12\frac{1}{4}$ in., tail to $2\frac{3}{8}$ in. Sexes about equal in size. In field, light brown (buffy) rump is distinguishing, if square-tipped tail is not sufficient. Has dark throat patch, unlike whitish throat of bank swallow; upper parts steel blue. Temperature, 100.2-111.2°F.

3 subspecies recognized: Northern, Lesser, and Mexican. Northern breeds from central Alaska to Cape Breton Island south over all of United States except Florida and Rio Grande Valley. Migrates in winter through Florida and Central America to Brazil and Argentina. From California Pleistocene.

Nests usually under eaves of a barn or on cliff. Nest gourd-shaped, of clay or mud, with a lining of grass, leaves, feathers, and wool. Eggs 4-5, white or creamy and pinkish with markings of reddish-brown and darker brown, $\frac{3}{8}$ by $\frac{3}{8}$ in.; weight $\frac{1}{16}$ oz. Incubation 12-14 days, by both sexes. 1 annual brood.

Food almost exclusively insects. Examination of 375 stomachs showed a few wild berries and spiders, but otherwise only insects such as cotton boll weevils, alfalfa weevils, chinch bugs, rice weevils, and so on. Nests commonly in colonies and in this way often attracts attention, which is not always to be desired.

Such a useful species that every effort should be made to give it complete protection. Should be encouraged to nest where its services may be used. Known popularly in some areas as "eaves swallow."

Purple Martin, 611
Progne subis

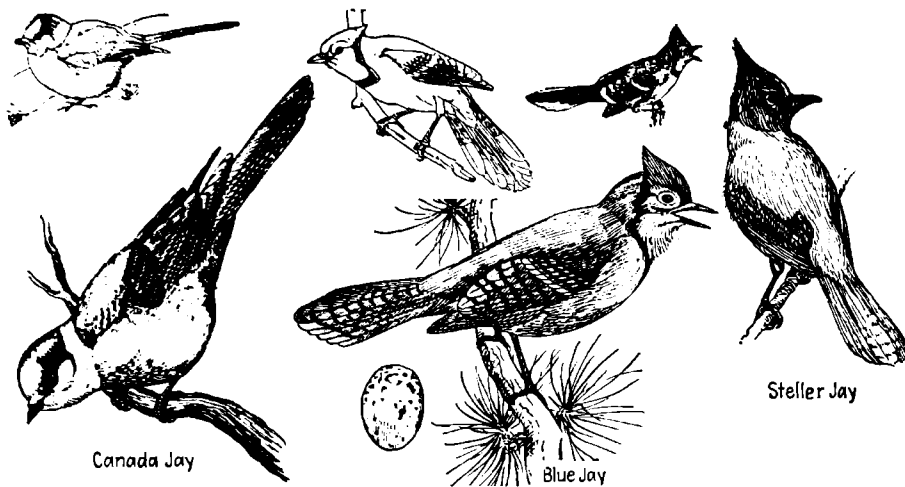
Length to $8\frac{1}{2}$ in., wingspread to $16\frac{3}{4}$ in., tail to $3\frac{1}{2}$ in., with $\frac{1}{10}$ -in. fork, bill to $\frac{1}{10}$ in. Female smaller than male. Largest of associated swallows. Male uniformly blue-black above and below. Female with gray under parts and neck ring. Commonly about buildings and birdhouses.

Breeds from Cape Prince of Wales in Alaska to New Brunswick, south through central Alberta to Mexican border, on to Vera Cruz and along Gulf Coast. Winters in Brazil but occurs in migration in Central America, Venezuela, and Guiana. Accidentally in Bermuda and British Isles.

Nests in open country not far from water, never in forests. Nest in hole, cliff, building, gourd house, or special colonial martin house. Outside of nest mud, inside grasses and feathers. Eggs 3-8, pure white, $1\frac{1}{2}$ by $\frac{3}{4}$ in. Incubation about 13 days, chiefly or wholly by female. Annual broods 1 or, in South, 2.

Food almost solely insects. Examination of stomachs showed cotton boll weevils, squash bugs, butterflies, destructive moths, grasshoppers, dragonflies, drone honeybees but no worker bees, a considerable number and variety of flies, and mosquitoes. Flock of martins active about an orchard saves much spraying.

Entirely useful and worthy of every possible protection. Largest of swallows, responds so splendidly to encouragement by man that its range should be increased rather than decreased. Unfortunately, must compete for nesting sites with gangster-type starlings and English sparrows. Such a fight is usually an uneven one.



Canada Jay

Blue Jay

Steller Jay

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Corvidae. CROWS AND JAYS

Canada Jay, Whiskey-Jack, 484 *Perisoreus canadensis*

Length to $12\frac{1}{2}$ in., wingspread to $17\frac{1}{2}$ in., tail to $6\frac{1}{3}$ in. Female smaller than male. Appears in field like a large gray bird with dark cap, long tail, white throat, inquiring nature, lots of nerve, and somehow a sense of humor. Some suggest it looks like a long-tailed gray crow or overgrown chickadee. Young dark slate colored. Sexes alike.

3 subspecies: Canada, Rocky Mountain, and Alaska jay. Canada jay breeds from Alaska and northern Mackenzie to Labrador and south to central British Columbia, northern Minnesota, and northern New York. Rocky Mountain jay ranges south to Arizona and New Mexico.

Nests mostly in coniferous forests, often in swampy areas. Nest large, neatly built of twigs, lined with grasses, mosses, and lichens. Eggs 3-5, grayish or yellowish, $1\frac{1}{8}$ by $\frac{7}{8}$ in. Incubation 16-18 days. 1 annual brood. Commonly travels in pairs. Breeds early in spring.

Food: will eat anything that can be considered edible, cleaning up garbage about camps, eating fish, eggs, meat, soap, toothpaste, and great quantities of insects. Stomach of one bird had approximately 1,000 tent-caterpillar eggs in it. Also eats mice and beetles.

Always interesting camp follower. Called camp robber and "Hudson Bay bird." In judgment of careful bird students, Canada jay is considered as highly beneficial in spite of often violently expressed opinions of individuals from whom this inquisitive bird has taken things left idly about.

Blue Jay, 477 *Cyanocitta cristata*

Length to $12\frac{1}{2}$ in., wingspread to $17\frac{1}{2}$ in., tail to 6 in., bill to $1\frac{1}{4}$ in. Weight to 3 oz. Female smaller than male. Colored conspicuously blue, white, and black, with long round-tipped tail and conspicuous head crest. "Sassy," in disposition and generally noisy. Temperature, $106.2-110.2^{\circ}\text{F}$.

3 subspecies include Northern, Florida, and Semple's. Northern breeds from southern Alberta to Newfoundland, south to Colorado, central Texas, and Virginia. It ranges somewhat farther south in winter but may be resident through year. Sometimes found in New Mexico. Defended home territory $\frac{1}{2}$ mile across.

Nests in dense woods or small groves, especially in coniferous trees. Nest in crotch or branch close to trunk; 5-50 ft. above ground, of sticks with lining of roots. Eggs 3-6, greenish-gray or olive with brown blotches, $1\frac{1}{8}$ by $\frac{7}{8}$ in.; weight, 12 g. Incubation 15-17 days, by both sexes. 1-2 annual broods.

Food, as indicated by examination of 300 stomachs, shows bird is much more good than bad. Stomachs of 292 showed 75% vegetal, remainder animal matter including 14% discarded shells of hen's eggs. Most animal matter was insects, spiders, snails, and even fishes, frogs, salamanders, and birds and their eggs. Nuts and acorns, 42%. Speed, 20 m.p.h.

As indicated above, probably more useful than injurious. Certainly, a bird which provides all observers with plenty of excitement whether one attempts to locate a nest, to interpret sounds, to follow activities, or to determine statistically economic importance.

Steller's Jay, 478 *Cyanocitta stelleri*

Length to $13\frac{1}{2}$ in. Tail to $6\frac{1}{8}$ in. long. Wings and tail rounded. Conspicuous as a large blue and black bird with a long erect crest. Fore parts brownish-black to black. Wings, under parts, and tail deep blue. Only crested deep blue bird in its range. Sexes similar. Young only slightly duller than adults.

6 subspecies include Steller's (Alaska to Washington), Queen Charlotte (British Columbia), Coast (Oregon and California), Blue-fronted (California to Lower California), Black-headed (British Columbia to Nebraska), and Long-crested (southern Rocky Mountains from Utah into northern Mexico).

Nests in pines and other cone bearers, to 10 ft. above ground. Nest bulky, of twigs, moss, and grass with finer lining. Eggs 3-6, dull pale bluish-green with blotches of brown and lavender. Family stays together for some time, and flocks of 6-8 birds in late summer are probably a family unit.

Food largely seeds, acorns, and berries in fall. An estimate of long-crested jay's food is $\frac{1}{3}$ animal food and $\frac{2}{3}$ vegetable food, latter being largely acorns and former unfortunately including many birds' eggs. Call is a loud repeated *shook* or *whack* or *kwhesh*.

Like other jays closely related to it, probably does some harm and some good. As with most members of family, its reputation varies with different persons according to behavior that may have been observed. It should be neither completely destroyed nor unduly encouraged.



California Jay



Magpie



Northern Raven

PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Corvidae. CROWS AND JAYS

California Jay, 481
Apelocoma caerulea

Length to 12 in. Tail to $6\frac{1}{2}$ in. A blue jay without any crest, with head, tail, and wings blue, back brownish-gray, under parts pale gray, head flattened, breast with a dark crossband, and in some subspecies throat with light vertical streaks. Sexes colored alike. Young gray above than are parents.

7 subspecies recognized including long-tailed (Washington to California), Nicasio (northern California), California (San Francisco to Mexico), Belding's (northwestern Lower California), Xantus's (southern Lower California), Woodhouse's (Oregon to Wyoming, Texas, and California), and Texas (central and west central Texas).

Nests in scrub oak or piñon pine, 3-30 ft. above ground. Nest an outer basket of twigs and small sticks with a lining of grass stems, rootlets, and finally hair. Eggs 3-6, light bluish-green somewhat flecked with rusty brown markings. Very secretive about nest. Family remains together for a time.

May stay around farm buildings picking up food and generally observing what there is to see and to eat. Commonest view one has of them is flying away, displaying a rich blue tail and wings, followed perhaps by smaller birds whose nests they may have robbed.

Like other birds of family, they need watching and one must be charitable to forgive some of their misdeeds. Probably if a fair balance were struck, they would be found no more useless than many who decry their presence.

Magpie, 475
Pica pica

Length to 21 in., wing to $8\frac{2}{5}$ in., tail to $11\frac{1}{10}$ in., bill to $1\frac{2}{5}$ in. Weight $5\frac{3}{4}$ oz. Nostrils covered with bristles. Extremely long tail that tapers half its length, conspicuous black and white markings serve to identify. Sexes colored alike. Young with dull black in usual glossy black areas.

Breeds from Alaska Peninsula southward, mainly near coast, to southern Manitoba, south through eastern Washington and eastern slope of Sierra Nevada to Arizona and northern New Mexico, east occasionally to Iowa, Wisconsin, Illinois, Michigan, Ontario, Hudson Bay, and even Quebec. Related yellow-billed magpie, now restricted to southern California, found in California Pleistocene.

Sometimes lives in colonies or nests in scattered colonies in thickets or trees. Nest size of a bushel basket, of twigs and dry plant material, with a good lining sometimes cemented with mud, and with a lateral, covered entrance. Eggs 7-10, grayish or green, dotted, dashed, and blotched with purple or brown; $\frac{5}{16}$ oz. Incubation 18 days.

Food, grasshoppers, large black crickets, ground beetles, codling moth larvae, rodents, and carrion. 85 kinds of plants and animals recognized in stomach contents including reptiles, amphibians, worms, birds, crustaceans, spiders, and scorpions.

As an insect eater, it has no related superiors; as an enemy of rodents it is excellent. However, it robs nests of domestic poultry, kills young chickens, attacks newly sheared lambs or sick or wounded cattle, and by its incessant chattering annoys many people; undoubtedly a pest where its numbers are large.

Raven, 486
Corvus corax

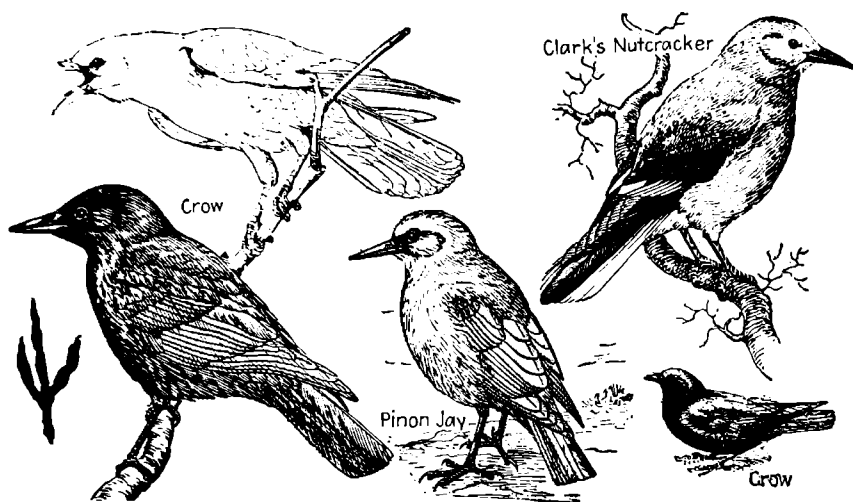
Length to $26\frac{1}{2}$ in., wingspread, to 56 in., tail to 11 in., bill to $3\frac{1}{4}$ in. Female smaller than male. Black all over. Nostrils hidden by bristle tufts. Tail appears rounded at tip when bird is flying; should not be confused with smaller crow. Sexes alike. Young like adults.

2 subspecies, Northern and American raven. Northern breeds from northwestern Alaska to Greenland, south to states of Washington, Minnesota, Virginia, and parts of Georgia. American raven ranges from southeastern British Columbia to North Dakota, south to Nicaragua. From California Pleistocene.

Nests usually in forests or along sea-coast. Nest of coarse sticks lined with finer plant material, in a tall tree or on a rocky cliff. Eggs 5-7, pea-green or olive with spots of brown, gray, or lavender, $1\frac{5}{16}$ by $1\frac{1}{8}$ in. Incubation 20-21 days, by both sexes. 1 annual brood.

A useful scavenger, killing great numbers of mice, rats, and injurious insects, but may also destroy young lambs and chickens, and attack weak or injured animals of larger size. Shows exceptional cleverness in outwitting more powerful animals, particularly where a number of ravens work cooperatively.

Because of destruction of livestock and poultry where ravens are abundant, their numbers have been greatly reduced; over much of their original range they may no longer be found. Certainly great flocks comparable to those of crows no longer exist near intensively cultivated areas.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Corvidae. CROWS AND JAYS

Crow, 488
Corvus brachyrhynchos

Length to 21 in., wingspread to 39 in., tail to 8 in., bill to 2 $\frac{2}{3}$ in. Weight about 20 oz., variable. Female averages smaller than male. Color all black. Lacks separated long-pointed throat feathers of raven, is smaller, and has squarer tail. Young only slightly duller than adults.

5 subspecies include Eastern, Southern, Florida, Western, and Northwestern crows, all with minor differences. Eastern breeds from southwestern Mackenzie to Newfoundland, south to Maryland and northern Texas. Winters generally between north and south boundaries of United States. From Pleistocene of Florida and California.

Nest a platform of sticks in top of tree or on branch close to trunk, rarely in bush or where there are no trees, lined with finer plant materials. Eggs 3-9, pale blue-green to olive with gray or brown blotches or markings, 2 $\frac{3}{16}$ by 1 $\frac{2}{5}$ in.; weight $\frac{3}{4}$ oz. Incubation 15-18 days, probably by both sexes. 1-2 annual broods.

Food: consumes enormous quantities of insects, carrion, and weed seeds, as well as eggs of other birds including game birds; also grain waste, mice, gophers, and rabbits. When grasshoppers are abundant, average crow stomach contains about 100. In farming regions, 38% of food may be corn. Known to kill newborn lambs.

Unbiased students contend that while crows do much damage, on average they do more good than harm. To sportsmen serve as buffer animals which may be shot to relief of more valuable species. Numbers do not decrease much by organized shooting because birds only become more wary. Have great roosts during winter months.

Piñon Jay, 492
Cyanocephalus cyanocephalus

Length 11 $\frac{3}{4}$ in., wing 6 in., tail 4 $\frac{3}{4}$ in. General color a grayish-blue. In flight shows relatively short wings and nearly square-tipped tail. Throat and chest gray-streaked. Female resembles male but is slightly smaller and duller. Young duller yet, with blue only on wings and tail.

Resident from central Washington to central Montana and south to northern Lower California and northwestern Nebraska. Sometimes found on California coast and sometimes as far east as eastern Nebraska and Kansas.

Nests in colonies, in piñon pines, junipers, and oaks. Nest deep, bulky, compact, with well-formed inner cup 5-12 ft. from ground. Eggs usually 4-5, bluish-white spotted or streaked with brown or sometimes blotched. Stay in pairs even though great numbers nest and feed at common points.

Food chiefly nuts of piñon pine in season, but also seeds of yellow pine, black pine, juniper berries, wild berries, and insects such as grasshoppers. Injury has been caused by these birds to some growing crops such as grains and even watermelons, particularly where birds act in unison in flocks.

Undoubtedly, where flocks of these birds congregate near cultivated lands bearing crops, they may cause much injury. However, in general they are easily and effectually frightened away by scarecrows and a little shooting.

Clark's Nutcracker, 491
Nucifraga columbiana

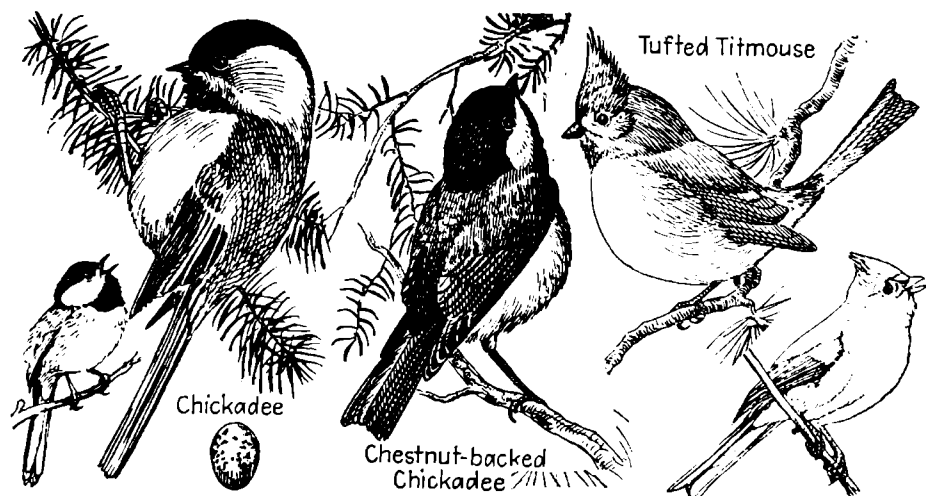
Length to 13 in., tail to 8 in. Face white and rest of body gray. Central tail feathers black but rest of tail white above and below. Wings glossy black but secondary feathers are white-tipped. Sexes colored alike. Young paler gray and with breast apparently more spotted.

Breeds from southern Alaska to South Dakota, south through mountainous areas to northern Lower California, Arizona, and New Mexico. In winter moves farther southward. Occasionally found in western Nebraska, Missouri, Arkansas, Iowa, and Wisconsin.

Nest built in coniferous forests, a platform of twigs bound with bark, grass, and needles, sometimes lined with wool quilted together to form a mat. Eggs 3-5, pale gray-green, sparsely flecked or spotted with brown, gray, or lavender, particularly at larger end. Incubation 16-22 days. May nest in zero weather.

Food in summer, nut-like seeds of certain pines, berries of cedar, beetles, caterpillars, grasshoppers, and destructive black crickets of their range. In fall, food is essentially nut-like fruits of pines. Young fed hulled seeds of pine, regurgitated by parents.

Interesting birds about camps, but rather too noisy, and inquisitive for their own good. May destroy baits on trap lines and win hatred of trappers. Common and welcome about many national parks where they may come to feed out of hand, in competition with ground squirrels so popular with most persons.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Paridae. TITMICE, VERDINS, BUSHTITS

Black-capped Chickadee, 735

Parus atricapillus

Length $5\frac{3}{4}$ in., wingspread $8\frac{1}{2}$ in., tail $2\frac{3}{4}$ in. Entire crown, throat, and hind neck black, without a crest; in Acadian chickadee, brown. Outer margins of wing coverts whitish (in Carolina chickadee, not white). Sexes colored alike. Young like adults in general appearance.

4 subspecies include Black-capped, Long-tailed, Oregon, and Yukon; 17 other subspecies in 6 other closely related species. Black-capped ranges from northern Ontario to Newfoundland, south to Missouri and North Carolina, intergrading with Long-tailed which ranges westward. Tree species.

Nests in forests, open woodlands, parks, or orchards, in hollow stub, tree, or bird box 1-50 ft. above ground, with 1-in. entrance and depth to 12-in. Nest moss-lined. Eggs 5-13, white, spotted and speckled with brown, $\frac{3}{4}$ by $\frac{1}{2}$ in. Incubation by both sexes, 11-13 days. 1-2 annual broods.

Food largely insects and insect eggs. Stomachs of 289 yielded 68% animal food and remainder plants. Stomach of one had 450 eggs of plant lice in it; in fact, plant lice seem a favored food. Also included in food are bark beetles, weevils, scale insects, spiders, flies, wasps, ants, and similar creatures. Defended home territory 100 yd. across.

Obviously highly beneficial. Not estimated is number of people made happy by cheery visits these birds pay to window feeding stations or to popular woodland paths. State bird of Maine. Carolina chickadee, State bird of Carolina. Song pitch, 3,027-3,700 c.p.s.

Chestnut-backed Chickadee, 741

Parus rufescens

Length to 5 in. Like black-capped chickadee of East in general pattern but with back a chestnut-brown and sides with a touch of chestnut. Black bib, white cheeks, and dark cap are like those of eastern species. Chestnut back distinguishes species from other chickadees in same area.

3 subspecies: chestnut-backed (from Prince William Sound, Alaska, to Sonoma County, Calif., and to western Montana), Nicasio (along coast of middle California), and Barlow's (along coast from California to Monterey Bay). 6 other species including black-capped in genus.

Nests in holes in dead poles or small trees, with 1-in. opening. Nest usually lined abundantly with soft material such as feathers, rabbit fur, and down. Eggs 4-8, white, spotted with brown or lilac especially at larger end, or possibly plain. Incubation by both sexes.

Related chickadees of West include Oregon and Long-tailed, subspecies of *P. atricapillus*, and Grinnell's and Short-tailed, subspecies of *P. gambeli*, mountain chickadee. This species is common chickadee in coast mountains and in heavy spruce forests.

Economic importance is like that of other chickadees in that it controls insect populations to be found on finer parts of woody plants at any time of year.

Tufted Titmouse, 731

Parus bicolor

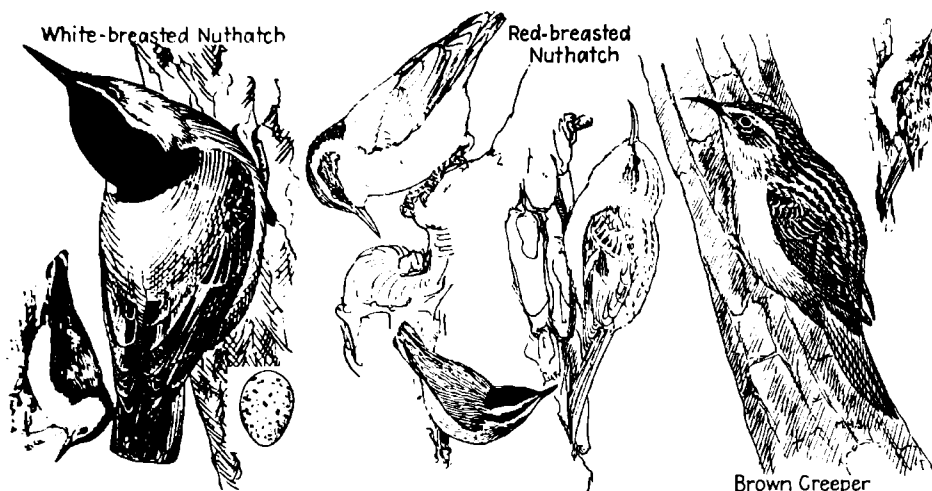
Length to $6\frac{1}{4}$ in., wingspread to $10\frac{3}{4}$ in., tail $3\frac{1}{8}$ in. Female smaller than male. Conspicuous because of its high crest, which is not shared by other birds smaller than a sparrow. Color almost uniformly sooty-gray, with basal half of outer tail feathers whitish. Sexes colored alike.

Breeds in resident range from Nebraska to Maine, south to central Texas, Gulf Coast, and central Maine. Occasionally found in Wisconsin, Michigan, Ontario, New York, Maine, and Connecticut. Formerly stayed in well-wooded regions but is now found in parks and in street trees within its range.

Nests in natural tree cavity or deserted woodpecker hole, in stub, fence post, pole, or bird box, usually 40-60 ft. above ground and lined with soft stuffs. Eggs 5-8, $\frac{3}{4}$ by $\frac{1}{2}$ in., white or creamy brown with spots of brown or lavender. Incubation chiefly by female. Annual broods 1 or, in South, 2.

Food: examination of stomachs of 186 showed 66.5% animal matter and remainder plant stuffs. Latter included largely nuts, acorns, and wild berries. Caterpillars and wasps made up over 50% of total food eaten. Included also were tent-caterpillar eggs, spiders, sawfly larvae, scale insects, and tree hoppers.

Obviously, from its food record, is essentially beneficial. Certainly because of its interesting appearance and habits, it is popular with bird students. Often as inquisitive as its near relative the chickadee, even perching on gun barrels of still hunters. State bird of West Virginia.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes

Family Sittidae

White-breasted Nuthatch, 727
Sitta carolinensis

Length $6\frac{1}{8}$ in., wingspread $11\frac{1}{2}$ in., tail $2\frac{1}{4}$ in., bill, $1\frac{1}{8}$ in. Female smaller than male. Breast white, back blue-gray, cap black. Goes up and down tree trunks, with head up or down, with equal ease. Female slightly duller on top of head than male but otherwise much like male. Young only slightly different.

subspecies include White-breasted, Florida, Rocky Mountain, Slender-billed, Inyo, San Pedro, and San Lucas nuthatches. White-breasted ranges from southern Manitoba to southern Quebec, south to northern Texas and South Carolina. Defended home territory 25-48 acres. About trees in woods, parks, or streets.

Nest usually in a cavity, such as abandoned woodpecker's hole or a bird-house, 2-60 ft. above ground, lined with fine stuffs. Eggs 5-10, white or pinkish with brown or lavender spots, especially at larger end, $\frac{3}{8}$ by $\frac{3}{8}$ in. Incubation by female, 13 days. 1 annual brood.

Food in winter, 25% animal matter; in spring, 80%. One bird's stomach had 1,629 cankerworm eggs in it. Kinds of insects eaten are both injurious and beneficial so bird may be neutral in importance to man. In orchards, does much good during seasons when caterpillars are active and in winter feeds on codling moth pupae.

Apparently liked even by those who do not know its name, judging from great number of popular names it has, such as "upside-down bird" and "twirl-around-a-twig," which describe its antics. One of standard visitants to window feeding stations and beloved by those who must stay indoors.

Red-breasted Nuthatch, 728
Sitta canadensis

Length to $4\frac{3}{4}$ in. Wingspread to $8\frac{1}{2}$ in. Female smaller than male. Smaller than commoner whitebreasted nuthatch, with a broad black eye band and rusty beneath. Male with top of head black with bluish gloss, which is gray to rear in mature female. Young like adults of same sex.

Breeds from upper Yukon to southern Quebec and Newfoundland and south in mountains to Lower California, Arizona, and North Carolina; in lowlands rarely south of Michigan, Minnesota, and New York. Winters from southern Canada to southern California, New Mexico, and northern Florida. Migrations rather irregular. Found chiefly in evergreen forests.

Nests chiefly in evergreen forests but sometimes in mixed forests. Nest in a cavity in decaying wood, 5-70 ft. above ground, with 1-in. entrance, with lining of feathers and bark, with pitch smeared around entrance. Eggs 4-8, $\frac{3}{8}$ by $\frac{3}{8}$ in.; laid May-June. Incubation 12 days, chiefly by female. 1 annual brood.

Active on trunks and large limbs of trees, working with head up or down, gleaning from bark insects that make up its food though it does eat seeds of spruce and balsam. Beetles seem to be important in insect food. May practice some food storage, particularly taking food from feeding stations and hiding it.

Certainly an interesting species, and probably much more useful as an insect destroyer than harmful as a tree destroyer. Species is surprisingly tame and feeds close to human beings even when found in remote areas.

Family Certhiidae

Brown Creeper, 726
Certhia familiaris

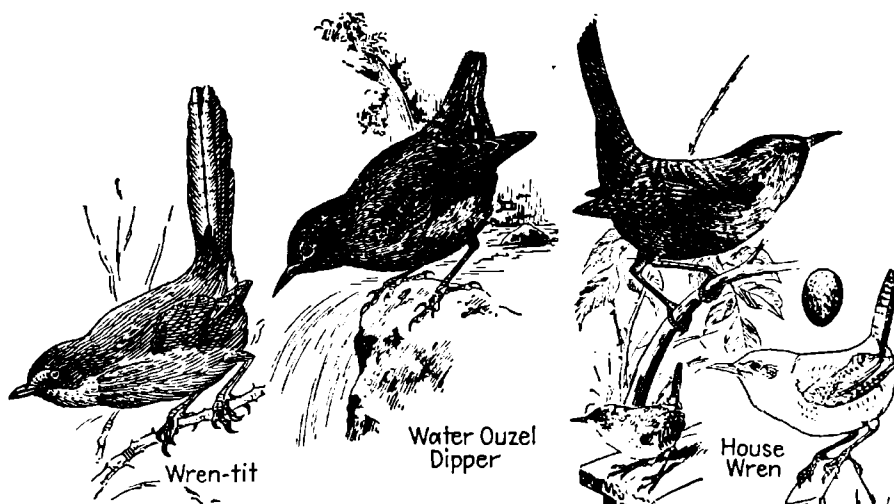
Length $5\frac{3}{4}$ in., wingspread to 8 in., tail to 3 in., bill, $1\frac{1}{8}$ in. Streaked, dark-brown above and gray beneath. Tail feathers stiff and used as props when working on tree trunk, from base up. Sexes colored alike. Young possibly not so dark as adults.

Breeds from central Manitoba to southern Quebec, south to eastern Nebraska and North Carolina. Winters over most of breeding range, south to central Texas, southern Alabama, and southern Florida. Rocky Mountain creeper, a subspecies, extends range to Alaska, south into Mexico, breeding south to New Mexico. In deep woods or about street or orchard trees.

Nests usually in swampy woodlands, under loose piece of bark or in old hole. Nest of twigs, bark, feathers, hair, and cobwebs. Eggs 5-9, white to gray, sparingly spotted with reddish- or purple-brown; $\frac{5}{8}$ by $\frac{1}{2}$ in. Incubation 15 (?) days, by female. 1-2 annual broods.

Food, insects and insect eggs gleaned from trunks and branches of trees. In home life, female builds nest and incubates eggs but male assists in bringing food to young. Food includes ants, plant lice, leaf hoppers, codling moths, caterpillars, spiders, pine seeds, and suet from feeding stations.

Activities almost entirely valuable to man's interests and therefore deserving of every protection. More abundant than most people appreciate because not easily seen unless one is alert for such birds. Its fine call is a good test for hearing as some persons cannot hear it at all.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes

Family Chamaeidae

Wren Tit, 742

Chamaea fasciata

Length to about 7 in., with upper parts brownish-olive and lower parts pale cinnamon or yellowish-brown. Tail wren-like but longer, and bill long and curved, like that of wren. Crown, hind neck, wing, and tail feathers grayer than other parts; sides of head and neck grayish-olive. Iris white. Sexes colored alike.

5 subspecies include Coast, Ruddy, Gambel's, Pallid, and San Pedro wren tits, which range from Columbia River in Oregon to Mexican border in humid areas to west of mountains. They favor cover for most part.

Nest in low bushes or trees, rarely if ever over 4 ft. above ground. Nest made of woven grass, bark, roots, and other vegetable materials, usually lined with hair of horses or cattle. Nest generally well-hidden from prospective enemies. Eggs 3-5, but usually 4, pale bluish-green.

Food essentially insects, gleaned from cover in which bird so easily disappears but from which it is so frequently heard. Only family of birds restricted to North America.

Probably useful as insect destroyer. Confounds naturalist who feels confident that it will be easy to locate a bird capable of making such a loud commanding sound. Common about San Francisco Bay area and invites plenty of inquiry by naturalist visitors to region.

Family Cinclidae

Dipper, Water Ouzel, 701

Cinclus mexicanus

Length 8½ in., wing 3½ in., tail 2½ in. Weight 2½ oz. Slate-gray but paler beneath; head and neck feathers faintly tipped with brown; tail and wing feathers darker brown. Eyelids marked with white. Sexes colored alike. Young with grayer crown and whitish throat. Temperature, 106°F.

Breeds from near tree limit in northwestern Alaska to central western Alberta, and south to southern California and southern New Mexico. Accidental in Black Hills of South Dakota and in western Nebraska. An allied race found in Mexico and Guatemala.

Nest on ledge, in gorge or canyon, over water or often under waterfall; also on rocks in midstream, and on beams under bridges. Nest bulky, roofed over, with side entrance; made of plant materials such as growing mosses, weeds, pine needles, with a dry inner nest of finer materials. Eggs 3-5, white. Incubation 15 days.

Food, aquatic insects and small fish, but mostly caddis-fly larvae, water beetles, black-fly larvae, dragonflies, and their kind. Food gleaned from wet rocks or underwater. Can walk through water, walk under it, or swim through it when air temperature is 50°F. below zero. Faster water flows, better this bird seems to like it.

Could not conflict with man's interests if it wanted to do so. Never abundant and too small to capture large fish even if its diet were essentially fish. Its marvelous song and unusual ways hold interest of any fair-minded person who enjoys atmosphere of a gorge and a dashing stream, of which dipper is part.

Family Troglodytidae

House Wren, 721

Troglodytes aedon

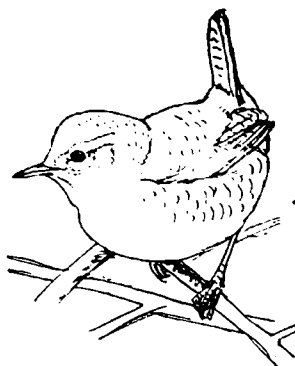
Length to 5½ in., wingspread to 7 in., tail to 2½ in. Weight ½ oz. Tends to cock tail over back; grayer brown than associated wrens, without conspicuous face stripings. Sexes colored alike. Winter wren has dark-barred belly and light line over eye. Carolina wren larger and redder, with white eye stripe.

Several subspecies include Eastern and Western house wrens. Eastern breeds from Michigan to New Brunswick and south to Kentucky and South Carolina. Winters from Texas and Gulf States into Mexico. Western house wren breeds from British Columbia to Wisconsin and south to Lower California and Kentucky. Winters south into Mexico.

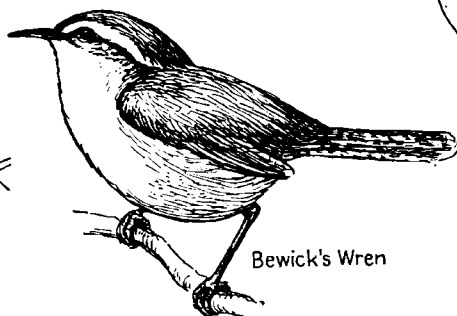
Often polygamous, one male maintaining more than one household. Nests in old woodpecker hole or under eaves, filling all possible sites in neighborhood. Nest of coarse sticks, with finer lining. Eggs 5-12, pinkish-white with red-brown spots, ⅔ by ⅓ in. Incubation 11-13 days, by both sexes. 1-2 annual broods.

Food largely insects, animal matter equaling 98% of total. Unfortunately, may drive other birds away and even break up other nests. Some pairs may mate for life. Birds are amusingly noisy and active, and by using bird-houses make many a youngster happy and satisfied for his efforts.

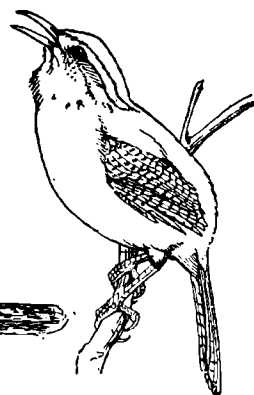
Probably essentially useful though some bird students think house wren is one of worst of villains because it does not live harmoniously with other species of birds. State bird of Ohio, and related Carolina wren is State bird of South Carolina. Song, 2,050-7,125 c.p.s. Temperature, 98.6-107.5°F.



Winter Wren



Bewick's Wren



Carolina Wren

PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Troglodytidae. WRENS

Winter Wren, 722
Troglodytes troglodytes

Length to 4 $\frac{1}{4}$ in., including 1 $\frac{1}{4}$ -in. tail and $\frac{1}{2}$ -in. bill. Conspicuously smaller and darker than common house wren, with belly cinnamon-brown, with conspicuous black bars on flanks and beneath, but those on back indistinct. Bill and tail much shorter than in house wren; outer tail feathers, $\frac{1}{4}$ in. shorter than next.

Eastern winter wren breeds from southern Alberta to Newfoundland and south to central Minnesota and northern Georgia. Winters south of breeding limit to central Florida and Texas. 9 recognized subspecies include Eastern, Aleutian, Kiska, Tanaga, Unalaska, Smedley, Kodiak, and Western and extend range north and southwest.

Breeds in damp evergreen woodlands, near water, in brush or a hole, up to 10 ft. above ground. Nest of twigs with moss lining. Eggs 4-10, $\frac{3}{8}$ by $\frac{3}{16}$ in.; white with dots of purple and brown, frequently crowded toward larger end. Incubation mostly or wholly by female. Usually 2 broods a year.

Food, ants, beetles, moths, dragonflies, caterpillars, plant lice, bugs, sawflies, lady beetles, leaf hoppers, and other insects and mites, snails, and other invertebrates. Song a long vigorous warbling, an explosion of musical sounds somewhat like that of ruby-crowned kinglet. Call note much like that of song sparrow.

Undoubtedly useful bird and not conceivably injurious. Popular with ornithologists because of its song and in part because it is relatively uncommon as compared with house wren in much of its range. Such a volume of song from such a small bird reminds one of wren tits of West.

Bewick's Wren, 719
Thryomanes bewickii

Length to 5 $\frac{1}{2}$ in., including 2 $\frac{3}{8}$ -in. tail and $\frac{3}{4}$ -in. bill. Wingspread to 7 in. Female smaller than male. Relatively small wren, with abnormally long white-edged tail, longer than wings, with rather conspicuous brownish-white line over eye. Sexes colored alike.

Breeds from southern Nebraska, through Illinois, Michigan, and Pennsylvania, south to central Arkansas, Mississippi, Alabama, Georgia, and South Carolina. Winters from northern part of range to Gulf Coast and central Florida. Occasionally found north into New York and New Jersey. 14 subspecies recognized including Texas, Seattle, Santa Cruz, San Joaquin, and Guadalupe.

Nests in cavities in a great variety of places, being particularly inclined to nest near where human beings live. Nest of sticks, bark, grass, fur, and feathers. Eggs 4-6, $\frac{3}{8}$ by $\frac{1}{2}$ in.; white or pinkish with reddish-brown or lilac spots, most abundant at larger end. Incubation to 15 days, with 2-3 annual broods the rule.

Food chiefly insects. Known to include cotton boll weevil in its diet. Song has been described as like that of a bold house wren, more vigorous and clean-cut in every way. Larger than long-billed marsh wren and found, in winter, frequently in normal habitat of that species.

A useful destroyer of injurious insects and an interesting songster within its range. More hardy than some commoner wrens.

Carolina Wren, 718
Thryothorus ludovicianus

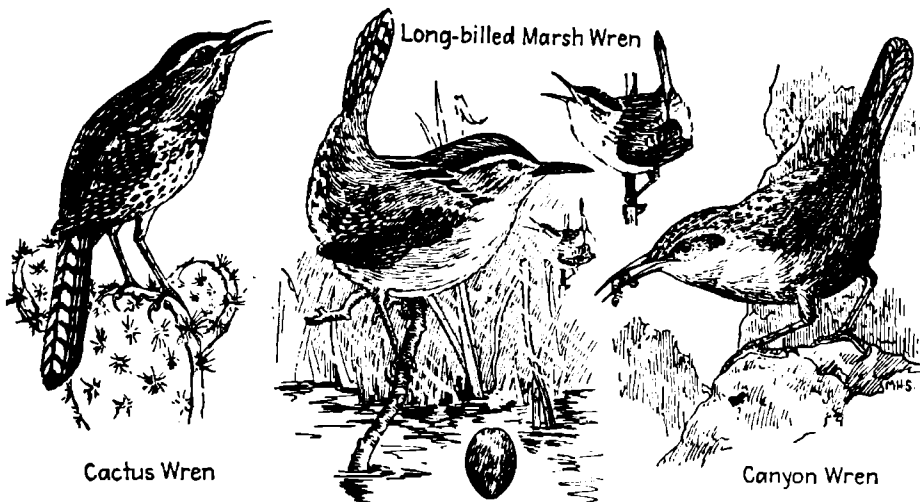
Length to 6 in., including 2-in. tail and $\frac{3}{4}$ -in. beak. Wings to 2 $\frac{3}{4}$ in. long. About size of smaller sparrows. Conspicuously reddish for a wren, with buff under parts and without streaks or bars other than a conspicuous long white or pale brown stripe over each eye. Dimpler before molting period.

Breeds from southeastern Nebraska to lower Hudson Valley and Connecticut, south to Texas and northern Florida but sometimes found north to Wisconsin, Ontario, and Maine. Florida wren is a subspecies from southern Florida, and Lomita wren a subspecies of lower Rio Grande Valley and vicinity. At home in brushlands and forests. Resident.

Nests are bulky masses of plant materials with feathers and finer grass lining, in holes in stumps, brush piles, fallen treetops, or about buildings. Eggs 4-6, $\frac{3}{4}$ by $\frac{3}{8}$ in.; white or cream, with cinnamon, red-brown, and lavender markings. Incubation 12 days, chiefly by female. 2-3 annual broods. Female commonly smaller than male.

Food: in 291 stomachs nearly 95% of food was insects, remainder being chiefly seeds. Food includes chinch bugs, cockroaches, cotton boll weevils, cucumber beetles, grasshoppers, crickets, moths, and other insects. Song an ecstatic burst commonly described as resembling *tea kettle* repeated or a repeated *wee-udel*.

Justly popular because of its song and food habits and because it continues as resident in territory abandoned in winter by some of commoner wrens. Its size and color also make it distinctive. Tail flips over back in typical wren fashion. Can be enticed to banding station by hamburger. No injurious habits. State bird of South Carolina.



Cactus Wren

Long-billed Marsh Wren

Canyon Wren

PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Troglodytidae. WRENS

Cactus Wren, 713
Heleodytes brunneicapillus

Length to 8 in., wing to $3\frac{1}{2}$ in., tail 3 in. Female slightly smaller than male. Tail rounded. Feathers of back brown with white middle streaks. Tail feathers brown and black. Under parts white. Young with back spotted instead of streaked, with white and black spots on chest, smaller and duller.

3 subspecies include Northern, Bryant's and San Lucas cactus wrens. Northern cactus wren ranges from southern California to Nevada, Utah, New Mexico, and central Texas south to northern Lower California and northern states of Mexico. Other subspecies in Lower California.

Builds many dummy nests, in which they may roost as well as rear young. Nest a 6-in. globe of dried grasses, with side entrance; may be used and remodeled in different years; sometimes lined with feathers; also may be used by mice. Eggs 3-7, white or buff, with many red-brown spots.

Food essentially insects. Sings through year but more commonly in summer. Song described as like grinding 2 small millstones together. Nests placed in cactuses are perfectly protected from most enemies.

Essentially a useful species and one of birds which give life and voice to desert at times of the day when it might otherwise be wholly quiet and empty. State bird of Arizona.

Long-billed Marsh Wren, 726
Telmatodytes palustris

Length to $5\frac{1}{2}$ in., wingspread to 7 in., tail to $1\frac{3}{4}$ in., bill $\frac{1}{2}$ in. Brown above with a black crown, unstreaked, but with black back with white stripes. White stripe over eye. Under parts white, flanks cinnamon brown. Gray as feathers become worn. Sexes colored alike. Young like adults.

9 subspecies include Long-billed, Worthington's, Marian's, Louisiana, Alberta, Prairie, Western, Tule, and Susan marsh wrens. Long-billed breeds from Quebec and Ontario to Virginia. Winters from New Jersey to Florida. Other subspecies cover United States and adjacent territory.

Male stakes out territory and erects many dummy nests. Female accepts same territory; makes own nest with inside doorstep. Nests of woven plants, about size of indoor baseball, with side entrance. Eggs 5-9, chocolate or speckled, $\frac{3}{8}$ by $\frac{1}{2}$ in. Incubation 13 days. Young at first helpless. Annual broods, 1-3.

Food essentially insects gleaned from plants. Particularly active tail. Song, something like a musical sewing machine, may be heard night or day in marshes. Scolds vigorously at human or other intruders. Song pitch, 1,925-5,475 c.p.s.; median, 4,400 c.p.s. Defended home territory with one female, 13,000-15,000 sq. ft.

Certainly does no harm to man's interests and helps somewhat in controlling insects in a region where they are normally overabundant. Preyed on by many animals, and nests used by bees, tree frogs, and other animals.

Canyon Wren, 717a
Catherpes mexicanus

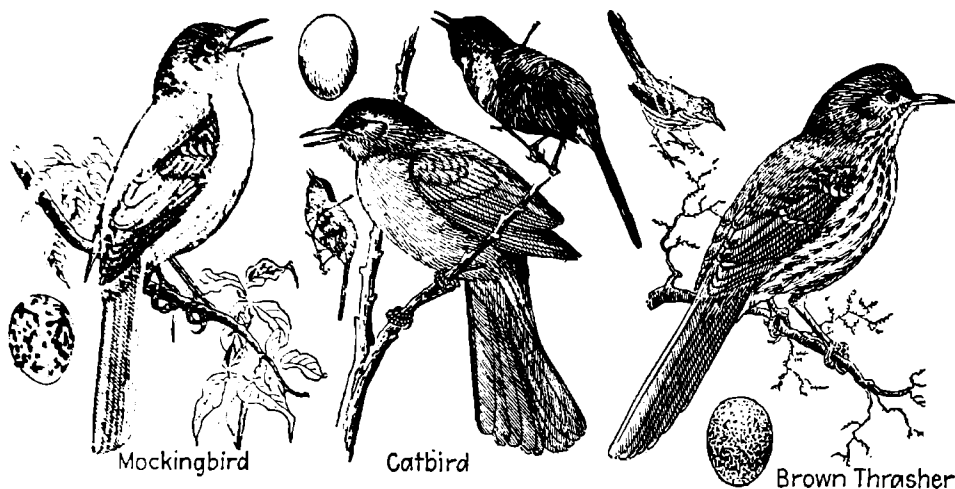
Length to $5\frac{1}{2}$ in. Wing to nearly $2\frac{1}{2}$ in. and tail of similar length. Male and female colored alike, brown but for white on throat and breast, with upper parts lighter brown, head grayish, and tail rusty brown with narrow black crossbars. Pure white on under parts to the fore, becoming rusty to rear.

From southern British Columbia to Idaho and northern Colorado, south through mountainous areas to Texas, Sonora, Chihuahua, and Lower California. 2 closely related subspecies, white-throated and dotted wrens, have more restricted ranges for most part but are in general in part of same area.

Nest is built in a crevice in rocks, in a tunnel or cave, or on a ledge, composed of twigs, moss, and grass often with wool or feather lining, bulky, made by female. Eggs 3-5, white, with reddish-brown or light blue-gray spots around larger end.

Known best for its ringing song, which may be heard almost from snow to snow and is characterized by descending the chromatic scale, a feature that has given the bird common name of scale bird. Singing of scale is succeeded and preceded by less conspicuous notes.

Of no great economic importance because it does not live in an agricultural area but is of great interest as representative of a wild environment. It takes over to some extent where the equally vociferous water ouzel leaves off.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Mimidae. MOCKINGBIRDS, THRASHERS

Mockingbird, 703
Mimus polyglottos

Length to 11 in., wingspread to 15 in., tail to 5¾ in., bill to ¾ in. Female smaller than male. Like a large slender long-tailed gray and white robin, with large white patches on wings and tail, which show conspicuously in flight. Lacks black face mask of somewhat similar shrikes.

2 subspecies include the Eastern and the Western. Eastern ranges from eastern Nebraska to Ohio and Maryland and south to Texas and southern Florida. Occasionally in New York and New England and up to Nova Scotia. Western extends range through central California and south to Vera Cruz.

Nests usually about buildings, in trees or shrubs or at edges of woods. Nest 1-50 ft. above ground, of twigs with a lining of finer materials such as roots or grass. Eggs 3-6, greenish to bluish to gray, with small red- or yellow-brown spots, 1½ by ¾ in. Incubation 14 days, by female. 2-3 annual broods.

Food in spring and summer largely insects including ants, flies, wasps, cotton boll weevils, grasshoppers, bugs, caterpillars, and also spiders. In summer and autumn it changes to a diet of fruits of trees and shrubs such as sumac, mountain ash, wild grape, Virginia creeper, barberry, honeysuckle, bitter-sweet, and Juneberry.

Ranks high as a beneficial bird and certainly is popular in song and story. Official State bird of Arkansas, Florida, Texas, Tennessee, and Mississippi, which gives some evidence of where it is most abundant and most appreciated. It may damage fruit in some parts of South if better food is not available.

Catbird, 704
Dumetella carolinensis

Length to 9½ in., wingspread to 12 in., tail to 4¾ in. Weight 1¾ oz. Temperature, 106°F. Slate-gray, with a black cap and rusty chestnut under tail. Tail seems to be long and loosely hung, yet large and broad when bird is in flight. Sexes and young colored essentially alike.

Breeds from British Columbia and western Washington to Nova Scotia and south to northern Utah and New Mexico and northern Florida. Winters in Southern States and on to Cuba and Bermuda through Mexico to Panama. Accidental in Europe.

Nest deeply hollowed, made of twigs, bark, and leaves lined with rootlets, in dense shrubbery 3-10 ft. above ground, appears bulky. Eggs 4-6, glossy, greenish-blue without markings, 1 by ¾ in.; weight, ½ oz. Incubation 12-13 days, by both sexes. 1-3 annual broods. Speed, 16 m.p.h.

Food in spring, almost solely insects; in summer and fall, more largely fruits and vegetable matter. In 645 stomachs examined, 44% of food was animal, remainder vegetal. 75% of animal food was ants, beetles, and caterpillars. Mewing, car-like call (768 c.p.s.) well-known. Song pitch, 1,100-4,375 c.p.s.

Where an abundance of wild fruit available, does little damage and surely not enough to offset good done in destroying harmful insects. During time young birds are being reared, 96% of food given them is insects. Important enemy of destructive gypsy moth where it is a serious pest.

Brown Thrasher, 705
Toxostoma rufum

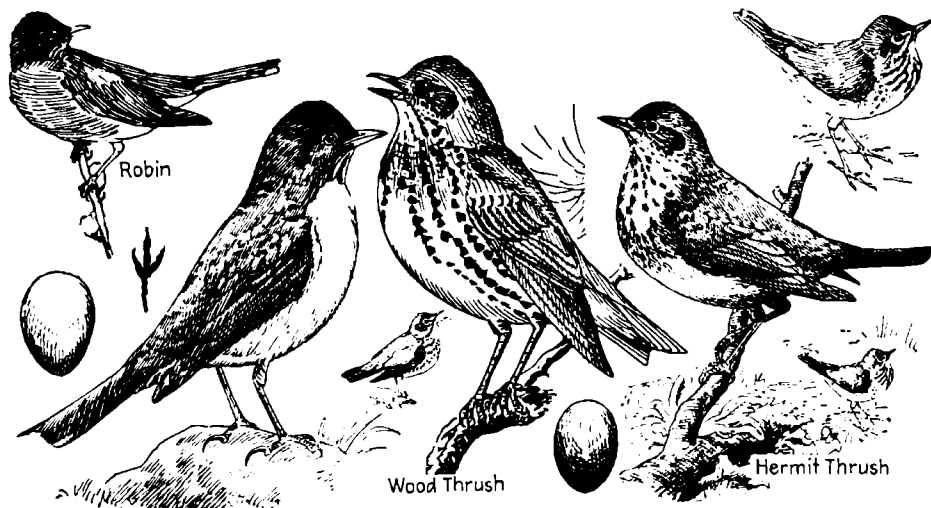
Length to 12 in., wingspread to 14¾ in., tail to 5¾ in., bill to 1½ in. Female smaller than male. Like a larger, slimmer robin, but redder above and striped below, with a longer, more loosely hung tail, which is rounded at tip. Sexes colored alike and young like adults. Temperature, 108.3-110.8°F.

Breeds from southern Alberta to western Quebec and Maine, south to Gulf Coast, Louisiana, and central Florida. Winters from southeastern Missouri and North Carolina to Texas and central Florida. 6 related species including 13 subspecies extend range of thrashers throughout warmer United States and northern Mexico.

Nest usually in brushland, on ground, in brush piles or low shrubbery. Nest bulky, of twigs, sticks, and leaves, with finer lining. Eggs 3-6, white or greenish, well-dotted with reddish-brown, 1½ by ¾ in. Incubation by both sexes, 13-14 days. Annual broods, 1-2 or, in South, sometimes 3.

Food in spring, almost entirely insects, spiders, and worms. In 266 stomachs, 63% of food was animal matter, almost all being insects. Insects include May beetles, white grubs, cucumber beetles, cotton boll weevils, snap beetles, wireworms, army worms, tent caterpillars, cutworms, cankerworms, grasshoppers, leaf hoppers, and wasps. Speed, 22 m.p.h.

Brown thrasher takes less fruit than catbird and so is more valuable from farmer's viewpoint. All brown thrashers should be considered as valuable birds worthy of protection the law gives them. Their mockingbird-like or catbird-like calls are usually given in 2's.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Turridae. THRUSHES, BLUEBIRDS

Robin, 761

Turdus migratorius

Length to $10\frac{3}{4}$ in., wingspread to $16\frac{1}{2}$ in., tail to $4\frac{3}{4}$ in. Female sometimes but not always smaller than male and generally with less brilliantly colored breast. Back gray, head black, breast chestnut to brown (black spotted in young), belly light gray to white, tail black. Temperature, $104.6-111.2^{\circ}\text{F}$.

4 subspecies include the Eastern, the Southern, the Northwestern, and the Western robins. Eastern breeds from tree limit of northwest Alaska to Newfoundland, south to Kansas and New Jersey. Winters from Kansas to Massachusetts, south to Gulf Coast and southern Florida. Other subspecies extend range through United States and Mexico.

Male comes north first, fights for territory, and mates. Nest in tree, under roof in abandoned building, or under bridge; made of mud and grasses. Eggs 3-5, blue, $1\frac{1}{4}$ by $\frac{5}{8}$ in.; weight $\frac{1}{16}$ oz. Incubation sometimes by both sexes but more often by female alone, for 11-14 days. 2-3 annual broods.

Food largely earthworms when they are available; about 57% vegetal and 43% animal matter. Insects eaten include grasshoppers, locusts, crickets, wireworms, leaf beetles, tent caterpillars, cutworms, cankerworms, army worms, ants, cicadas, and others; also, small snakes, sometimes to 1 ft. long, are eaten. Song pitch 2,200-3,300 c.p.s. Speed, 30 m.p.h.

Robins unfortunately eat fruits such as cherries, as well as insects which might also destroy the cherries. May flock into mulberry plantations and practically ruin crop, also destroy strawberries. With all their faults we still think highly of them. State bird of Michigan, Virginia, and Wisconsin.

Wood Thrush, 755

Hylocichla mustelina

Length $8\frac{1}{2}$ in., wingspread to 14 in., tail to $3\frac{1}{8}$ in. Bright brown above, breast and sides heavily spotted with round black spots. Redder about head than most associated thrushes. Sexes colored alike. Young much like adults. Smaller than brown thrasher and less slender in appearance.

Breeds from South Dakota through southeastern Ontario to southern Maine and south to eastern Texas and northern Florida. Winters from southern Mexico to western Panama and occasionally in Florida. Sometimes found in Bahamas, Cuba, Jamaica, Colorado, and Bermuda.

Nests in wooded land. Nest of leaves, grass, paper, or cloth, plastered with mud like robin's but with fine rootlets for a lining, either in a shrub or on a horizontal limb, to 12 ft. above ground. Eggs 3-5, greenish-blue and unmarked, $1\frac{1}{8}$ by $\frac{3}{4}$ in. Incubation for 12-14 days by both sexes. 1-2 annual broods.

Food known to include few useful insects or cultivated fruits, but many May beetles, weevils, Colorado potato beetles, cicadas, grasshoppers, tree hoppers, sawfly larvae, tent caterpillars, forest tent caterpillars, gypsy moths, and brown-tail moths. Song is one of finer of bird harmonies, 1,825-4,025 c.p.s., median 2,750 c.p.s.

The bird is obviously essentially useful and worth while. It does no harm, provides happiness to those who enjoy the relative quiet of woodlands, and is a thing of beauty at all times. State bird of District of Columbia.

Hermit Thrush, 759b

Hylocichla guttata

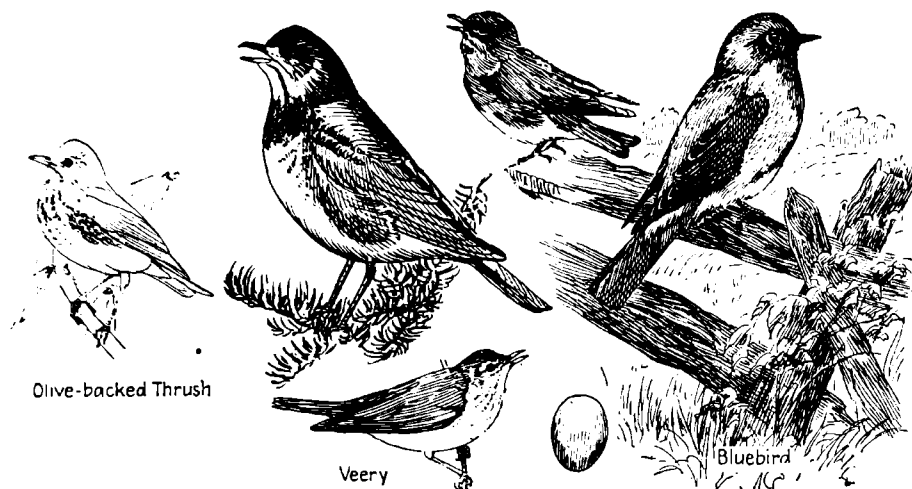
Length $7\frac{3}{8}$ in., wingspread to 12 in., tail to 3 in. Conspicuous because of reddish tail, which contrasts with brown back. Wood thrush is red about head; hermit, about tail; and veery is uniformly colored on back. Throat and breast not so spotted as in wood thrush. Sexes colored alike.

7 subspecies include Alaska, Dwarf, Monterey, Sierra, Mono, Audubon's, and Eastern. Eastern hermit thrush breeds from Yukon to southern Quebec, south to Minnesota, and in mountains of Maryland and Virginia. Winters from Ohio and Massachusetts, to Texas and Florida. Other subspecies to west.

Nests in a cool, wooded area or in pastures near woods but favors coniferous forests. Nest on or near ground, of leaves, moss, and bark compacted, with a finer lining. Eggs 3-5, plain greenish-blue, $\frac{2}{10}$ by $\frac{3}{10}$ in. Incubation 12-13 days. 2-3 annual broods. Nest may be deserted if only slightly disturbed.

Food principally insects such as ants, caterpillars, and beetles. In 68 stomachs, animal matter constituted 56% of food. Plant foods included berries of poison ivy, dogwood, privet, sumac, and wild grapes. Bird has habit of raising tail slowly at more or less definite intervals.

Popular with all bird students, particularly because of its remarkable evening song which expresses the direct opposite of the hurry and bustle of modern so-called civilized existence. If any bird can make a worried person forget his cares, it is the hermit thrush and his song even though it is often accompanied by the hum of mosquitoes. State bird of Vermont.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Turdidae. THRUSHES, BLUEBIRDS

1. Olive-backed Thrush, 758a
Hylocichla ustulata

2. Gray-cheeked Thrush, 757
H. minima

Length: (1) to 7¾ in.; (2) to 8 in. Wingspread: (1) to 13 in.; (2) to 13½ in. Both have uniformly olive or gray-brown appearance above. (1) has conspicuous brown eye ring and conspicuous buffy cheeks. (2) lacks a conspicuous eye ring, and has gray cheeks. Sexes of each similar.

Breeds: (1) from northwest Alaska to Newfoundland and south to northern California and mountainous Pennsylvania; (2) from northeast Siberia through Alaska to Newfoundland and south to Mackenzie and central Quebec. Winters: (1) in Mexico, Bolivia, Brazil, Argentina, and Cuba; (2) migrates through eastern North America to Colombia, Ecuador, Peru, Venezuela, Texas, and Kansas.

Nests: (1) in deep woods; (2) in stream thickets; (1) in bush or tree 4-25 ft. up; (2) on ground to 12 ft. up. Both of leaves, grass, and rootlets. Eggs 3-5; 1½ by ¾ in., light green-blue spotted with dark brown or lilac. Incubation of (1) 10-13 days, mostly by female. 1 annual brood. Incubation of (2) not known.

Quiet peaceful birds of hilly woodlands, shy and retiring. Song of (1) flute-like, with each phrase rising at end; of (2), like that of a veery, gradually dropping but rising quickly at end. Food roughly twice as much animal as vegetable matter, gathered largely from trees and shrubs.

Both are useful species favored by bird lovers, in part because of their song but not matching hermit or wood thrush in this respect. They live away from agricultural plants and so have little bearing on their prosperity although they probably do affect somewhat the economy of forests.

Veery, Wilson's Thrush, 756
Hylocichla fuscescens

Length to 7¾ in., wingspread to 10 in., tail to 3¾ in., bill to ¾ in. Uniformly cinnamon brown down back, head, and tail. In field, only a few spots show on throat and breast region. Key clues are uniform upper parts and unspotted under parts. Sexes colored alike. Young like adults, at least superficially.

Breeds from Michigan to southern Quebec, south to northern Indiana, northern Georgia, and North Carolina. Winters in Colombia, British Guiana, and Brazil after migrating through Yucatan and Central America. Willow thrush is subspecies ranging west to southern British Columbia and south to New Mexico, wintering south in South America to Brazil.

Nests in woodland usually near water. Nest usually on ground or, rarely, to 10 ft. up, of leaves, twigs, grasses, and bark with lining of fine roots, hair, needles, or grasses. Eggs 3-5, greenish-blue, 1½ by ¾ in. Weight, ½ oz. Incubation 10-12 days. 1-2 annual broods.

Food 57% animal matter, mostly insects and mostly those of woodlands including borers, caterpillars, bark beetles, ground beetles, curculios, and weevils. Few seeds of weeds taken, plant material being largely wild fruits. Oft-repeated descending song is worth hearing. Male defends nesting site more vigorously than female.

Undoubtedly useful in general economics of woodlands, in keeping insect pests in check. Popular with those who live where it can be heard and seen, and is missed when such an association is destroyed. Protected by law, and its enemies such as cats should be kept in control if it is to survive. Song, 2,375-4,025 c.p.s.

Bluebird, 766
Sialia sialis

Length to 7¾ in., wingspread to 13½ in., tail to 3½ in. Female smaller than male. Male little larger than English sparrow, with blue back and reddish breast. Young bluebirds like young robins, specklebreasted, lack red of breast, and are hardly so blue as either adult; more brilliantly colored than female.

2 subspecies include Eastern and Azure bluebirds. 2 related species, one of which is Eastern bluebird, breed from southern Manitoba to Newfoundland and south to central and eastern Texas and southern Florida. Winters from just north of Mason-Dixon line south to Gulf.

Nests in orchards and at edges of woods. Nest in a hollow such as a birdhouse or abandoned woodpecker hole. Usually from 3-30 ft. above ground. Nest lined with fine plant materials. Eggs 3-7, light blue or rarely white; ¾ by ½ in. Incubation for 12 days, by both sexes. 2-3 annual broods.

Food about 70% animal matter, including among insects grasshoppers, moths, crickets, beetles, bugs, ants, caterpillars of many kinds, and also spiders, myriapods, and earthworms. Plant foods include wild fruits such as those of wild grape, chokecherry, Virginia creeper, juniper, alder, bayberry, blackberry, sumac, and mountain ash. Speed, 17 m.p.h.

More valuable than associated robin because it rarely eats fruits man wishes to raise for himself. Bluebirds have decreased in numbers with increase in starlings, which drive bluebirds from their nesting sites. Song pitch, 2,200-3,100 c.p.s. Bluebird is State bird of New York and Missouri.



Mountain Bluebird



Golden-crowned
Kinglet



Ruby-crowned
Kinglet

PHYLUM CHORDATA. CLASS AVES Order Passeriformes

Family Turdidae

Mountain Bluebird, 768 *Sialia currucoides*

Length to $7\frac{1}{2}$ in., tail to 3 in. Female slightly smaller than male. Upper parts plain clear blue, wings more violet, under parts paler, belly white. Female: head and back gray, often tinged with greenish-blue, rump and tail blue. Young brownish or grayish, somewhat white-streaked.

Breeds from southern Yukon to southwestern Manitoba and, in mountains, south to southern California, Arizona, New Mexico, Chihuahua, and western Nebraska. Winters from California and Colorado south to Guadalupe Island, Lower California, Sonora, and other parts of northern Mexico, and to Oklahoma and Texas.

Probably most beautiful of all bluebirds. It, like better known species, will nest in birdhouses. It also nests in old abandoned woodpecker holes, commonly in aspen groves, or more commonly about man's buildings. Eggs 5-7, pale greenish-blue.

Food over 90% insects and remaining part largely of waste and wild fruits. Insects include cicadas, grasshoppers, cutworms, locusts, crickets, ants, bees, caterpillars, weevils, and other insects, some of which are caught on wing, birds acting as flycatchers.

This beautiful bird does so much good and seems to favor living near man so much that it should be encouraged to prosper wherever possible. Sufficiently well known and popular to have been selected as State bird for Idaho and Nevada.

Family Sylviidae

Golden-crowned Kinglet, 748 *Regulus satrapa*

Length to $4\frac{1}{2}$ in. Wingspread to 7 in. General color olive-gray with a white stripe over eye. Male with conspicuous orange crown bordered by black; female with conspicuous yellow crown. Young like adults first winter, but in juvenile plumage lack colored crowns and plumage appears loose and fluffy.

Breeds from central Alberta to southern Quebec and Cape Breton Island, south to Minnesota and New York and in mountains to North Carolina, with western subspecies ranging from Kenai Peninsula in Alaska to California. Winters from Iowa to New Brunswick and south to Florida and Mexico. Western subspecies from British Columbia to Guatemala.

Nests in evergreen forests. Nest 4-50 ft. up in evergreen, globular with small opening at top, of leaves, moss, lichens, and bark, feather-lined. Eggs 8-10, $\frac{5}{16}$ by $\frac{3}{16}$ in.; creamy white with brown and lavender spots. Incubation not known, but probably 12-13 days, probably by female. 1 annual brood.

Most active little birds, with surprising ability to withstand severe winter weather. Extremely shy about nesting. Will leave a partly built nest if it seems to have been discovered. Food in summer, caught on wing, but in winter gleaned from twigs and trunks, apparently consisting entirely of insects.

Economic importance great, since they destroy large numbers of insects as adults, pupae, or eggs and glean these from delicate parts of trees that could not be visited successfully by larger, heavier birds. Intensely interesting to bird lovers because of their activity. Call a high repeated *see*.

Ruby-crowned Kinglet, 749 *Regulus calendula*

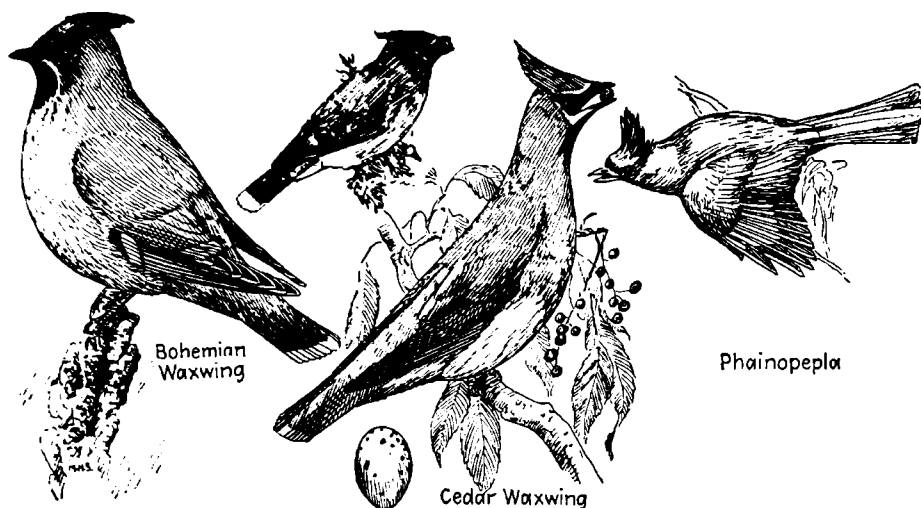
Length to $4\frac{3}{8}$ in., wingspread to $7\frac{1}{2}$ in., tail to $1\frac{9}{10}$ in. Olive-gray above with 2 pale wing bars. White ring around eyes. Male has scarlet patch on top of head which, except in courtship display, does not usually show. Golden-crowned kinglet has white eye stripe and yellow (female) or orange (male) crown.

4 subspecies: Eastern, Western, Sitka, and Dusky. Eastern breeds from northwest Alaska to west central Quebec and south to southern Arizona. Winters through United States, Mexico, Lower California, and Guatemala.

Nests among cone-bearing trees, usually 2-50 ft. up. Nest compact, either across or partly hung from a limb and hidden by foliage, composed of mosses and similar plants, hair-lined. Eggs 5-10, white with fine reddish dots, $\frac{5}{16}$ by $\frac{3}{16}$ in. 1-2 annual broods, but details about incubation and rearing of young not available.

Food: in 294 stomachs, animal food constituted 94%, chiefly leaf hoppers, plant lice, mealy bugs, scale insects, weevils, caterpillars, flies, and grasshoppers. Vegetable material consisted of wild fruits, including those of poison oak. Song a remarkable warble.

Nothing in bird chorus compares in surprising volume and tone quality with song of this diminutive bird. A male warbling his love song, erecting his brilliant red crown as he scurries through finer parts of some woody plant is worth seeing. Entirely useful, judging from its diet.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes

Family Bombycillidae

Bohemian Waxwing, 618

Bombycilla garrula

Length to $8\frac{3}{4}$ in. Wingspread to $14\frac{1}{4}$ in. Female smaller than male. Larger than cedar waxwing but is grayer on back and under parts, has some white and yellow on wings, and chestnut-red under tail rather than white. Sexes resemble each other but some females may be duller, with less yellow on wings.

Breeds from western Alaska to north-eastern Manitoba and northern Mackenzie, south to British Columbia and southern Alberta. Winters east to Nova Scotia and sometimes into Pennsylvania, Ohio, Michigan, Indiana, Illinois, Kansas, Colorado, California, and Arizona. Not a common bird in most of United States.

Nests in northern forests. Nest on branch, often high in a tree, built of roots, grass, and leaves with lining of hair, down, and feathers. Eggs 3-6, 1 by $\frac{7}{16}$ in.; blue-gray or slate spotted with dark brown and black. Larger than those of cedar waxwing, but smaller than those of European race of Bohemian waxwing. No data on incubation.

Food probably largely wild fruits, particularly in months it spends in United States. In breeding area in western Canada it unquestionably destroys large numbers of insects. Birds remain together in flocks like cedar waxwing. Call a low, rougher hissed zree than similar call of cedar waxwing.

In Europe, species is often found in great flocks the like of which have been recorded only once in America, in Nebraska when "every tree for miles was filled with them." These great flocks occur fairly regularly in Canada. Probably a useful species and is protected by law.

Cedar Waxwing, 619

Bombycilla cedrorum

Length to 8 in., wingspread to $12\frac{1}{4}$ in., tail to $2\frac{3}{4}$ in. Female smaller than male. Sleek brown bird, with conspicuous crest and a broad yellow band at end of tail. Wings with small wax-like secondary tips. Related Bohemian waxwing, nearly 1 in. longer, chestnut-red rather than white under tail and has white in wing.

Breeds from central British Columbia to Cape Breton Island, south to northern California, New Mexico, northern Arkansas, northern Georgia, and North Carolina. Winters through most of United States, south through Cuba, Mexico, Lower California, and Panama. Occasional in British Isles, Jamaica, Bermuda, and Bahamas. From California Pleistocene. Only 3 species in family.

Nests in orchards or isolated trees. Nest 4-40 ft. above ground, on horizontal limb, bulky, of coarse twigs, bark, and weed stems, with fine lining of rootlets, paper, hair, wool, or grasses. Eggs 4-6, pale blue, green, or gray, with black or dark-brown spots, $\frac{7}{16}$ by $\frac{7}{16}$ in. Incubation 12-16 days, by both sexes. 1-2 annual broods.

Food largely fruit and insects though most of fruit is wild. Estimated that a flock of 30 birds will destroy 90,000 cankerworms a month. Flock will settle on infested tree and clean it from top to bottom if undisturbed. Young are fed regurgitated food. Song pitch, 7,675-8,950 c.p.s. Defended home territory several feet across.

Qualified biologists consider it useful species in spite of fact that, in individual cases, flocks may do much damage to small fruits such as cherries. Flocks in winter always intrigue students of nature. Tame young in summer may even perch on a trout rod while they are being fed by parents.

Phainopepla

Phainopepla, Silky Flycatcher, 620

Phainopepla nitens

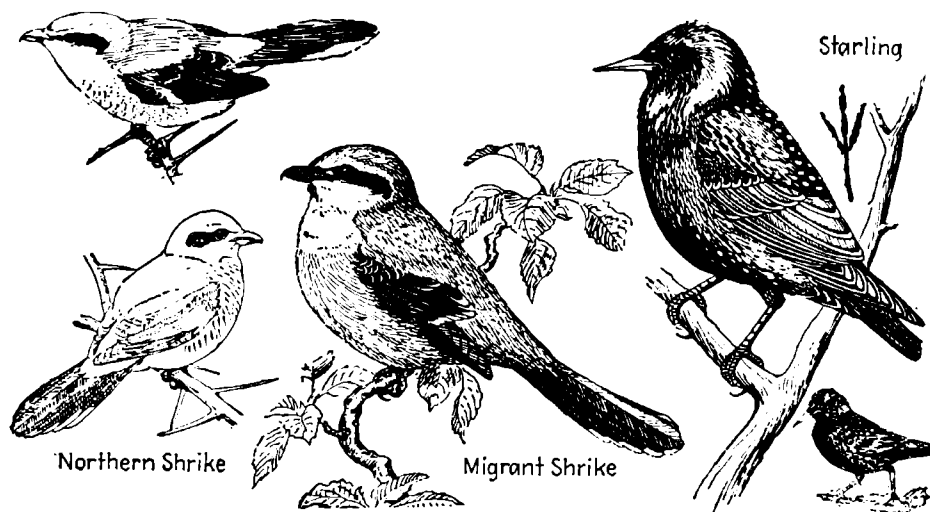
Length to $7\frac{3}{4}$ in. Adult male glossy greenish blue-black, except for white patch on inner webs of wings. Wings and tail less glossy than other parts of body. A high crest. Female plain olive gray, with longer feathers of crest black, and with under tail coverts white-edged. Young like female.

Breeds from central California to southern Utah and south through central Texas, Cape San Lucas, and northwestern Mexico. Winters from southern California south into Mexico. Occasionally in central Nevada and northern California.

Nests found in trees such as cottonwoods and mesquite, saddled on a branch, made of sticks, stems, and plant materials with a fine plant-down lining. Eggs 2-3, grayish-green to whitish, thickly spotted with brown, black, or faint lilac. Male often assumes duty of building nest, incubating eggs, and rearing young.

Behaves much like flycatchers, catching insect food on wing, and may stay together in flocks of a dozen or more young and old birds, probably members of a few families. May at times eat only berries like mistletoe, juniper, and elder.

Probably useful as insect check and always interesting to watch because of beauty and interesting feeding habits. Call a coarse ca-rack or ca-rac-ack. Moves to lower levels after breeding season has passed.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes

Family Laniidae

Family Sturnidae

Northern Shrike, 621

Lanius excubitor

Length to 10 $\frac{3}{4}$ in. Wingspread to 16 $\frac{3}{8}$ in. Female smaller than male. Larger than loggerhead shrike, with a finely barred breast, a flesh-colored rather than black lower bill, and without loggerhead's narrow black stripe above bill. Young browner than adults but with finely barred breast.

Breeds from northern Ungava to southern Ontario and Quebec, west to Hudson Bay. Winters south to Kentucky, Virginia, and North Carolina, with northwestern going on to northern California, New Mexico, and Texas. The winter shrike of the East. Related northwestern shrike extends range northwest to Alaska and south to northern British Columbia, Alberta, and Saskatchewan.

Nests in northern forests; on a limb or fork of a spruce, 5-20 ft. up; large and compact, of twigs and leaves with fur, feather, and lichen lining. Eggs 4-7, 1 $\frac{1}{10}$ by $\frac{7}{8}$ in.; white, bluish, or grayish-green with green, brown, purple, or gray markings. Incubation probably 15 days, with 1 or possibly 2 annual broods and nesting period centering in May.

Perches high, alone on a treetop from which it drops low, then flies directly and rises abruptly at end to new perch. Flight is easy. Food, large insects and small birds cornered in thickets by darting with incredible skill through brush tangles. Has been known to try to capture caged canaries behind windows. Song somewhat like a robin, mockingbird, or thrasher.

Considered useful as mouse destroyer and in West is effective in destroying gophers, which it kills with a sudden blow on back of head, according to John Muir. Protected by law.

Migrant or Loggerhead Shrike, 622

Lanius ludovicianus

Length 9 $\frac{1}{2}$ in., wingspread 13 in., tail to 4 in., bill to $\frac{9}{10}$ in. Female smaller than male. Related northern shrike has a slightly barred breast instead of the clear gray of migrant, and is larger. Both have a black mask through eyes, unusually long tails, and appear white and gray in flight.

6 subspecies include California, White-rumped, Nelson's, Island, and Loggerhead. Migrant breeds from southeastern Manitoba to New Brunswick, south to northeastern Texas and interior Virginia. Winters in Mississippi Valley, Texas, and southern New England. From California Pleistocene.

Nest a bulky affair of weeds and twigs with soft lining of feathers, grasses, and wool, 5-20 ft. above ground, in an orchard tree or thicker. Eggs 4-8, white or grayish-green, with purple and olive markings more obvious at larger end, 1 by $\frac{3}{4}$ in. Incubation 13-16 days, by both sexes, but mostly by female. 1-2 annual broods.

Food, insects, mice, birds, frogs, snakes, and shrews, often left hanging on thorns of trees. Perches high and alone and takes to wing by dropping low and taking a beeline with a steady wing motion, only to rise abruptly to its new perch. Speed, 45 m.p.h.

All serious studies indicate that while shrike does kill some other birds, its preying upon mice and large insects more than makes up for damage it does to useful species. It can cause terror in a flock of sparrows or other small birds. Protected by law.

Starling, 493

Sturnus vulgaris

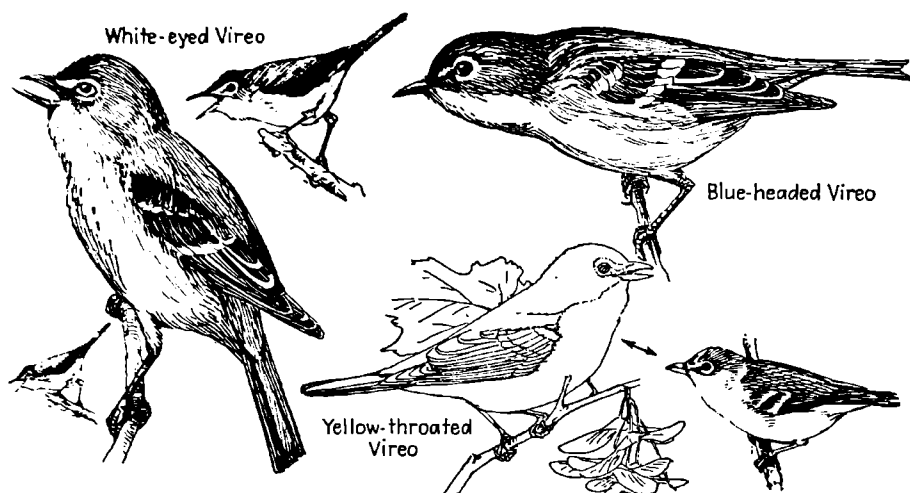
Length to 8 $\frac{1}{2}$ in., wingspread to 15 $\frac{1}{4}$ in., tail to 2 $\frac{9}{10}$ in., bill to 1 in. Weight to 3 $\frac{1}{2}$ oz. Temperature, 109°F. Female slightly smaller than male. Like a short-tailed blackbird, which flies in a varying shaped flock. Bill dark in fall, turning to yellow in spring. Blackish, with a gloss, flecked with buff and white.

Ranges from New Brunswick to western Ontario, south through Florida and Texas and spreading westward to California and northward to Hudson Bay. Allied bird found in Europe and in Asia. Fairly closely related to the mynah so common in Hawaii and in southern Asia. Introductions attempted from 1872 (Cincinnati) until finally successful in New York in 1900.

Nest a large bulky structure built of straw, grass, and twigs lined with feathers and other soft stuffs; placed in a birdhouse, cavity in a tree, or under eaves of a house. Eggs 5-8, pale blue or whitish, and glossy, 1 $\frac{1}{8}$ by $\frac{9}{10}$ in. Incubation 11-14 days, by both sexes. 1-3 annual broods.

Food highly variable. Stomachs of 2,157 birds showed 57% by weight animal matter, including many injurious insects. Plants include grain, cherries, strawberries, and similar fruits. Claimed that less than 6% of total yearly diet is cultivated plant products. Drives out more useful bluebirds and their kind. Flight speed, 52 m.p.h.

Probably carefully analyzed, starlings might be considered useful but they are pests about public buildings in cities, in orchard regions, and in grainfields. Better if they had never been introduced into America since they have driven out so many native beloved species. Hearing range, 700-15,000 c.p.s. Song pitch, 1,100-8,225 c.p.s.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Vireonidae. VIREOS

White-eyed Vireo, 631
Vireo griseus

Length to 5½ in., including 2½-in. tail and ½-in. bill. Wingspread to 8½ in. Female smaller than male. Yellowish-green, lighter beneath, with yellow sides and 2 conspicuous whitish wing bars. Iris of eye white. Bill black. Sexes colored alike. Young practically identical with adults.

Breeds from southeastern Nebraska through southern Wisconsin to Ohio and New York, south to Texas and southern Florida. Winters from Texas through Georgia, Alabama, and South Carolina to eastern Mexico, Yucatan, and Honduras. 4 subspecies include White-eyed, Key West, Bermuda, and Rio Grande, last 3 being local for most part.

Nests in low thickets and brushlands. Nest 2-8 ft. above ground, cup-shaped, suspended from a fork, made of mixed grasses, bark, moss, lichens, and cobwebs with a finer lining. Eggs 4, ¾ by ¾ in.; white, sparsely marked at larger end with fine black, purple, or lilac dots. Incubation 16 days. Annual broods, 1 or in South 2.

Food mostly insects such as caterpillars, ants, flies, and those that fly about thickets, usually caught in air; also includes some berries. Both parents care for young and are vigorous and self-sacrificing in defense. Cowbirds commonly lay their eggs in this vireo's nest. Song variable explosive, but has a sharp *chip* at either end.

Essentially a useful species because of its destruction of usually harmful insects. This species keeps itself hidden more than does red-eyed, but if its nest is approached it becomes highly aggressive no matter who the interloper may be.

Yellow-throated Vireo, 628
Vireo flavifrons

Length to 6 in. Wingspread to 10 in. Female smaller than male. Sexes colored alike. Olive-green above with white wing bars. Breast and throat a bright yellow, unlike that of any other vireo but much like larger yellow-breasted chat, which lacks white wing bars. Young like adults by first winter plumage.

Breeds east central Saskatchewan to southwestern Quebec, south to Maine, Florida, Alabama, Louisiana, and Texas. Winters from Yucatan and southern Mexico to Colombia, Venezuela, Cuba, and Bahamas. Essentially a bird of treetops of forests and towns.

Nests in June. Nest in broad-leaved tree, 3-50 ft. above ground, suspended between forks of a limb and cup-like, with spider silk used to fasten parts together. Eggs 3-4, 1½ by ¾ in.; white marked with purple-brown spots or rosy when newly laid. Incubation by both sexes, 12-14 days. 1 annual brood.

Food largely insects including caterpillars, houseflies, grasshoppers, cicadas, and beetles, with wild berries sometimes added when they are in their prime. Male sings on nest or near it, song often being confused with that of robin. Slower, more contralto, and more musical than that of red-eyed vireo.

Essentially a useful bird that is justly protected by law, damage to small berry fruits being more than compensated for by destruction of harmful insects. Furthermore, bird adds beauty of color and sound to summer landscape.

Blue-headed Vireo, 629
Vireo solitarius

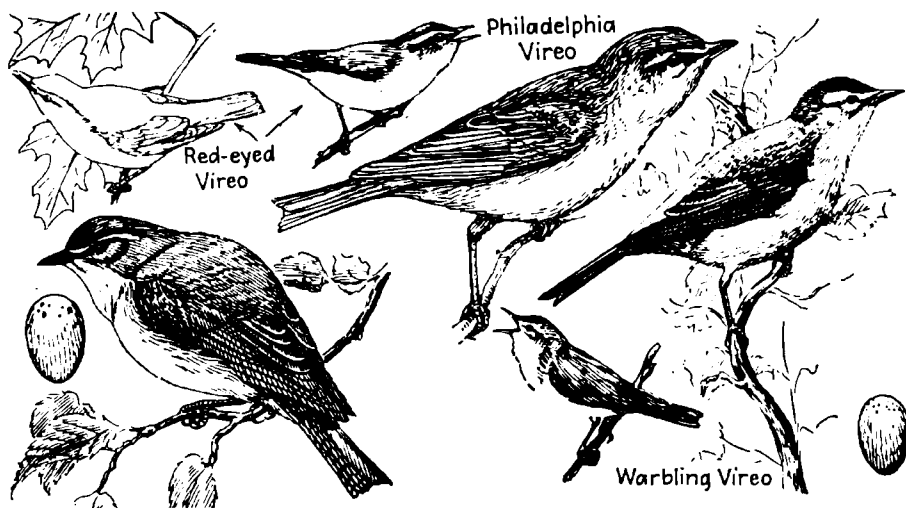
Length to 6 in., including 2½-in. tail and ½-in. bill. Wingspread to 9½ in. Female smaller than male. General color greenish, but with 2 conspicuous white wing bars and a conspicuous light ring around eyes. Under parts almost white. Throat glistening white. Top of head and back of neck blue-gray. Sexes alike.

Breeds from southern Mackenzie through northern Ontario, southern Quebec to Cape Breton Island, south to central Alberta, northern North Dakota, Minnesota, Michigan, southern Pennsylvania, and Rhode Island. Winters in Gulf States from Texas to Florida and from northern Nicaragua to eastern Mexico. 6 subspecies include Blue-headed, Mountain, Plumbeous, Cassin's, and San Lucas vireo.

Nests in or near a tree 5-12 ft. above ground. Nest a hanging cup, of beautifully mixed vegetable matter fastened together with spider web; often lined with down or fine needles. Eggs 3-4, ¾ by ¾ in.; white with small spots of brown, black, or reddish-brown. Nesting period June. Incubation by both parents. Usually 1 brood.

Food essentially insects including grasshoppers, bugs, beetles, caterpillars, sawflies, ants, dragonflies, crickets, and flies. Spiders are also eaten. Nesting is often close to that of more vigorous birds of prey.

A useful and interesting bird worthy of protection at all times. The cooperation of both parents in care of nest and young is always worth watching. Frequently does not show offense at those who would examine the nest and incubating parent.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Vireonidae. VIREOS

Red-eyed Vireo, 624
Vireo olivaceus

Length to $6\frac{1}{2}$ in., wingspread to $10\frac{3}{4}$ in., tail to $2\frac{1}{4}$ in. Female smaller than male. Lacks white wing bars of yellow-throated, white-eyed, and blue-headed vireos.

Breeds from central British Columbia to Cape Breton Island and south to northern Oregon, Colorado, western Texas, northern Coahuila, and central Florida. Migrates through eastern Mexico, Yucatan, and Central America to winter in Colombia, Venezuela, Ecuador, and southern Brazil.

Nests among woods or mixed forests or in shade or orchard trees. Nest a beautiful basket cemented with spider webs and hung from a horizontal crotch 4-50 ft. up, soft-lined. Eggs 2-4, white with brown spots at larger end, $1\frac{3}{16}$ by $\frac{3}{8}$ in. Incubation by both sexes, 12-14 days. Annual broods, usually 2.

Food essentially insects. One young bird known to eat 100 grasshoppers a day. Other insects include caterpillars, gypsy moth, and cankerworm caterpillars, bark beetles, leaf hoppers, mosquitoes, horseflies, and their kind. Monotonous call is continued through hottest days and late into season from treetops but is generally popular.

Economic value of this bird has never been questioned; worthy of every protection. One who has watched it build a nest and rear its young through rain and hot weather can appreciate it more than someone who may have heard its voice but never seen it. Song pitch, 2,375-5,850 c.p.s.

Philadelphia Vireo, 626
Vireo philadelphicus

Length to 5 in., including $2\frac{1}{8}$ -in. tail and $\frac{1}{2}$ -in. bill. Wingspread to 9 in. Female usually smaller than male. Yellowish-green, without bars on wings, and with under parts yellowish. Less bulky than red-eyed vireo. Has been compared to more active smaller Tennessee warbler and female black-throated blue warblers.

Breeds from northern and central Alberta to southern Manitoba, northern Ontario, New Brunswick, and Maine, south to North Dakota, Michigan, and New Hampshire. Winters from Cozumel Island, Yucatan, to Guatemala and Panama. Found in trees or bushes near homes, or in wilderness. Not common ordinarily.

Nests about edge of woods, in farm lands. Nest in a tree or shrub, 9-30 ft. up, a deep cup hanging in a fork, made of bark, grass, and lichens, lined with down, fine grass, or needles. Eggs 3-4, $\frac{3}{8}$ by $1\frac{1}{2}$ in.; white with brown, chocolate, or black markings. Nesting dates June. Incubation by both sexes. 1 annual brood.

Food mostly caterpillars, leaf beetles, and other insects destructive of trees and shrubs. Call much like that of warbling vireo but of a more dynamic nasal quality. Song similar to that of red-eyed vireo but weaker. Young birds practically indistinguishable from adults.

A useful destroyer of insect enemies of woody plants and an intriguing bird to amateur ornithologists, who may have difficulty in distinguishing it from species suggested above. It is not common in much of range of many vireos and is therefore more likely to be considered a discovery when it is found.

Warbling Vireo, 627
Vireo gilvus

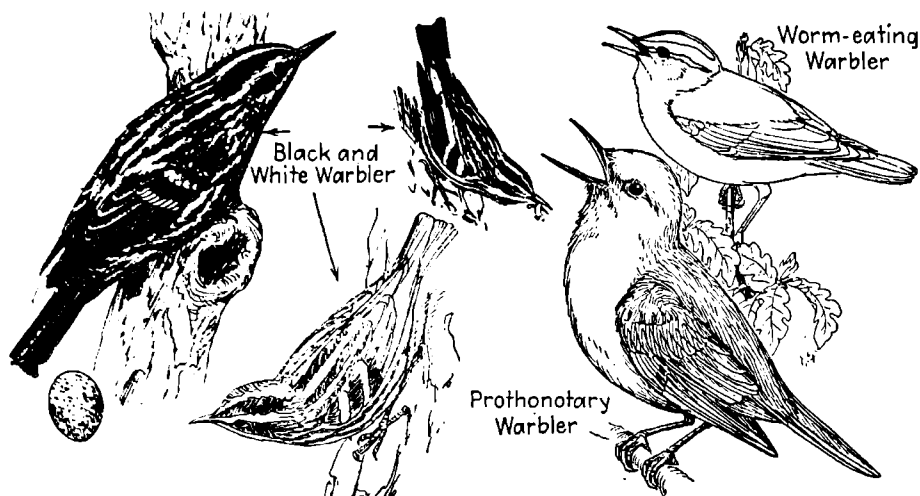
Length to 6 in., wingspread to $9\frac{1}{4}$ in., tail to $2\frac{1}{4}$ in. No wing bars such as are possessed by yellow-throated, blue-headed, and white-eyed vireos. Whitish instead of yellowish under parts of Philadelphia vireo; no gray cap or conspicuous black and white eye lines as in red-eyed vireo.

2 subspecies, the Eastern and the Western. Eastern breeds from Saskatchewan to Nova Scotia, south to Texas and North Carolina. Winters in unknown region but definitely south of United States. Western subspecies extends range on to southern British Columbia and winters south to western Guatemala.

Nest in shade trees, parks, or orchards but rarely in deeply wooded areas. Nest in maple, poplar, or similar tree, a basket hanging from a horizontal crotch far from trunk, 20-70 ft. up. Eggs 3-5, white with brownish spots, $\frac{3}{8}$ by $\frac{1}{2}$ in. Incubation 12 days, by both sexes. 1 annual brood.

Food, insects caught by gleaning through treetops or by pursuit through air, including leaf beetles, cucumber beetles, locusts, grasshoppers, cankerworms, and the like. Some wild fruit eaten but rarely is any cultivated fruit included. A bird of treetops, whence it sings a continuous warble far into summer.

Essentially a useful bird worthy of every protection not only against human beings but against more aggressive birds such as sparrows and starlings. Is, of course, protected by law but for its song alone would be worthy of extra efforts on its behalf.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Comptothlypidae. WOOD WARBLERS

Black-and-white Warbler, 636

Mniotilta varia

Length to $5\frac{1}{2}$ in., wingspread 9 in., tail $2\frac{1}{4}$ in. Weight $\frac{1}{3}$ oz. Covered with lengthwise black and white stripes. Creeps over trunk of tree like nuthatch or brown creeper. Can hardly be confused with any other bird. Female smaller than male.

Breeds from west central Mackenzie to Newfoundland, south to Texas and Georgia. Winters from southern Texas and Florida to Colombia, Ecuador, and Venezuela and occasionally in southern California and Lower California. Accidental in Bermuda and in state of Washington.

Nests usually on ground in a wooded area, usually at foot of a tree or shrub. Nest a mere depression in leaves or fashioned of finer plant materials. Eggs 4-5, creamy white, thoroughly spotted with chestnut, brown, or lavender, $\frac{3}{4}$ by $\frac{1}{2}$ in. Weight $\frac{1}{25}$ oz. Incubation by female, 13 days. 1 annual brood.

Food, insects such as plant lice, scale insects, caterpillars, gypsy moths, brown-tail moths, click beetles, forest tent caterpillars in adult, egg, larval, or pupal stages gleaned from trunks and branches of trees. Call a thin wiry sound, just audible to many persons and inaudible to others. Song pitch, 5,300-8,050 c.p.s.

This lovable bird is so confiding that one feels genuine resentment every time he sees a domestic cat near it. Value as a gleaner of insects from tree trunks cannot be questioned but its numbers near centers of human population are not what they should be.

Prothonotary Warbler, 637

Protonotaria citrea

Length to $5\frac{1}{2}$ in., including $2\frac{1}{4}$ -in. tail and $\frac{1}{2}$ -in. bill. Wingspread to 9 in. Female smaller than male. Sexes colored alike. Conspicuously colored bright yellow over all head and breast, with wings conspicuously blue-gray. Large for a warbler and restless. Breeding plumage results from wear, as only molt is in July-August.

Breeds from northeastern Nebraska through southern Minnesota, southern Wisconsin, and Michigan to Ohio, Delaware, and Maryland, south to northern Florida and Texas. Has been reported breeding in New York and New Jersey. Winters from Nicaragua to Colombia, Venezuela, and southern Mexico. Has been found north through New York to New Brunswick and in Arizona and Bermuda.

Nests usually in wooded swampy country, in a hole in a tree, usually made by some other bird and often over water, 1-25 ft. up. Nest may be bulky, of variety of vegetable materials. Eggs 3-7, $\frac{1}{10}$ by $\frac{3}{8}$ in.; creamy white with many chestnut, lavender, and purple spots. Nesting period May-June. Incubation to 14 days, by female. 1-2 annual broods.

Food mostly insects such as ants, flies, bees, locusts, and caterpillars; also spiders and many small water animals, including snails. Call a soft lisping chirp, but it gives a song like that of pine warbler or junco. One record shows a male making a nest alone, but it was not used.

A beautiful warbler, with an interesting nesting habit and an active manner, found rather uncommonly, but sometimes frequently in a rather gloomy environment. Male has remarkable display performance in courtship and fights rivals vigorously at that time.

Worm-eating Warbler, 639

Helminthos vermivorus

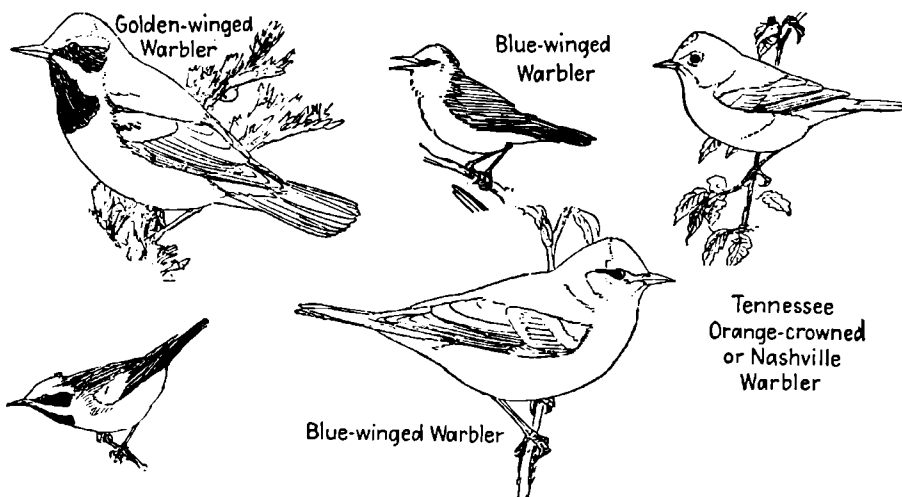
Length to $5\frac{3}{4}$ in. Wingspread to $8\frac{3}{4}$ in. Female smaller than male. General color dull olive green, darker above with black stripes on top of head alternating with lighter stripes. Wings seem to be unusually long and pointed and tail gives impression of being short and more rounded than would be expected.

Breeds from southern Iowa to western New York, southwestern Pennsylvania, and Hudson and Connecticut River valleys south to Missouri, Virginia, northern Georgia, and Alabama. Winters from southeastern Mexico to Panama, Cuba, Bahamas, and rarely in Florida. Haunts hillsides and ravines where there are woodlands.

Nests in deep woods and wooded ravines. Nest on ground, often beside a log or in a slight cavity; lined with moss and leaves and sometimes with hair. Eggs, 3-6, $\frac{3}{8}$ by $\frac{1}{2}$ in.; white spotted with lavender, chestnut, and dark reddish-brown, highly variable in markings. Nesting period late May and early June. Incubation 13 days, by female. 1 annual brood.

Walks about on ground searching its food of insects such as caterpillars, beetles, ants, and the like. No special interest in worms, according to evidence supplied by stomach examination. A relatively quiet, secretive bird with a call somewhat like that of chipping sparrow.

Unquestionably useful in control of insects and of interest to ornithologists, who easily identify it by its conspicuously marked head. It has some characteristics of the ovenbird.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Comptosylpidae. WOOD WARBLERS

Golden-winged Warbler, 642
Vermivora chrysoptera

Length to $5\frac{1}{4}$ in. Wingspread to $8\frac{1}{4}$ in. Female smaller than male. Male with black throat, yellow wing patches, yellow on forehead and below black cheek and eye patch; back, most of wings, and upper tail surface light gray, lower breast and belly almost white, in winter somewhat tinged with olive. Female duller than male.

Breeds from central Minnesota to eastern Ontario and Massachusetts, south to Iowa and northern Georgia, Tennessee, and Virginia. Winters from Guatemala to Colombia and Venezuela and occasionally in southern Mexico and Cuba. Usually found in shrubbery or even on ground but not commonly seen.

Nests May-June. Nest on or near ground in thickets of broad-leaved trees; of leaves, bark, and grasses or hairs, rather bulky, sometimes with caterpillar web added. Eggs 4 to rarely 7, cream to white, with pinkish, lavender, or brownish markings sometimes in blotches but not commonly so. Incubation by female, for 10 days. 1 annual brood.

Nest built in 2-3 days. Incubation begins immediately after eggs are laid. Young leave nest about 10 days after hatching. Song variously described as a repeated *zee* or *beee-bz-bz-bz* which is longer than similar call of blue-winged warbler.

The economic status of species has not been determined and probably does not need to be as it unquestionably is concerned with insect destruction and is free of destruction of plants and animals useful to man.

Blue-winged Warbler, 641
Vermivora pinus

Length to 5 in. Wingspread to $7\frac{1}{2}$ in. Female smaller than male. Essentially a yellowish warbler with 2 conspicuous white wing bars, a black-tipped tail, and a conspicuous but small black line through eye. Wings darker than back, which is pale olive. Blackish wing tips and shoulder.

Breeds from southeastern Minnesota to southern Massachusetts or Rhode Island, south to Kansas, Missouri, northern Alabama, Georgia, Maryland, and Delaware. Winters from southern Mexico to Guatemala and on to Colombia, migrating across Gulf of Mexico. Rare in United States southeast of Virginia.

Nests in field or pastures near woods or swampy thickets; on ground, late May-June. Nest of leaves, bark shreds, and roots bulkily thrown together, with fine grass lining. Eggs 4-5, $\frac{3}{4}$ by $\frac{1}{2}$ in.; white with sprinkling of delicate brown, lavender, and purple specks. Incubation 10-11 days, by female. 1 annual brood.

Essentially a warbler of low growth relying greatly on "sitting tight" to avoid detection. A female on nest may be touched before she will leave. Call like that of golden-winged warbler but much shorter, frequently including only first phrase. Young remain in nest for 8-10 days.

Undoubtedly a useful species, living in an area where it could do no damage to agricultural crops and with habits that would be beneficial if such crops were in the vicinity. Interesting to watch and generally popular with ornithologists.

Warblers

1. *Vermivora peregrina* (Tennessee), 647
2. *V. celata* (orange-crowned), 646
3. *V. ruficapilla* (Nashville), 645

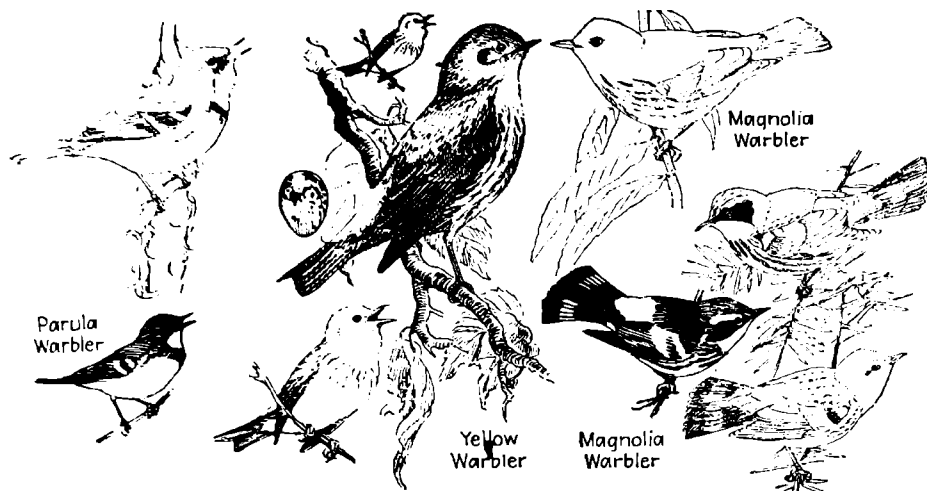
Length: (1) 5 in., (2) $5\frac{1}{4}$ in., (3) 5 in. Wingspread: (1) $8\frac{1}{4}$ in., (2) $8\frac{1}{4}$ in., (3) $7\frac{3}{4}$ in. Adult male: (1) plain olive with white under parts and white eye stripe; (2) plainer yet, with rarely evident orange crown and faintly streaked breast; (3) olive with yellow under parts and white eye ring.

Breeds: (1) from Yukon to central Quebec and south to British Columbia and New Hampshire; (2) from Kowak River, Alaska, to northern Manitoba; (3) from central Saskatchewan to Cape Breton Island and south to Nebraska and New Jersey. Winters: (1) from Oaxaca to Colombia and Venezuela; (2) from Gulf States to California; (3) from Vera Cruz to Guatemala and in Texas and Florida.

Nests all low in shrubs or on ground and made mostly of grasses, usually well-concealed. Eggs: (1) and (2), 4-5, $\frac{3}{4}$ by $\frac{1}{2}$ in.; (3) 3-5, $\frac{3}{4}$ by $\frac{1}{2}$ in.; all white to creamy and spotted and speckled with brown or lilac. Incubation of (3), 11 days, by female. 1 annual brood. This is probably similar in other species.

Birds are all active little warblers, singing from treetops and nesting on ground. Song of (1), like a chipping sparrow beginning with a *teetsee* and ending with a *dedede*; of (2), a continuous *chee* repeated and rising near end; of (3), a *teetsee* repeated and ending a stuttered prolonged *tiiti*.

All are probably useful as insect destroyers and none could possibly do any harm. Offer a challenge to amateur ornithologists to distinguish between them but are worth continued study both for song and for general beauty.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Comptothypidae. WOOD WARBLERS

Parula Warbler, 648a *Parula americana*

Length to $4\frac{9}{10}$ in. Wingspread to $7\frac{3}{4}$ in. General color bluish, with yellow breast and throat and a less conspicuous yellow patch on back. A dark band across yellow of breast and 2 broad white wing bars. Female lacks breast band or shows it only obscurely; also smaller than male.

Breeds from eastern Nebraska to Cape Breton Island, south to Texas, Louisiana, and Maryland, with southern subspecies from District of Columbia to Alabama and Florida. Winters from Bahamas and West Indies to Barbados and from Vera Cruz to Nicaragua, with southern subspecies in Florida and Bahamas. A bird of treetops.

Nests usually in evergreen tree in bogs and swamps where air is humid and lichens hang from branches. Nest in a bunch of moss hollowed out, with a side entrance, sometimes with hair lining. Eggs 3-7, $\frac{3}{4}$ by $\frac{1}{2}$ in.; white to creamy, with brown and gray spots. Nests mostly in June. Incubation by female, with 1 annual brood.

Young able to fly about by late August, when a slow southern migration begins. Food probably almost exclusively insects gleaned from trees and shrubs, but measuring worms are known to be favored in diet and tent caterpillars and gypsy-moth caterpillars are eaten.

Useful in destroying insect pests of common woody plants. Song a trill buzzing up scale and dropping near end. Plumage changes slightly through year, female in winter having blue areas more greenish while young are olive-brown to gray above and have pinkish feet that become gray with age.

Yellow Warbler, 652 *Dendroica petechia*

Length to $5\frac{1}{4}$ in., wingspread to 8 in., tail to $2\frac{1}{4}$ in. Female smaller than male. Appears superficially to be all yellow. Seen near at hand, male shows breast to be streaked with chestnut-red markings which are faint or lacking in female. No associated bird gives impression of being all yellow. Temperature, 101.5-108.2°F.

4 subspecies include Eastern, Alaska, California, and Sonora yellow warblers. Eastern breeds from eastern Alaska to southern Ungava, south to Nevada, New Mexico, northern Georgia, and South Carolina. Winters from Yucatan to Guiana, Brazil, and Peru.

Nests about farm lands and in suburban areas, in low trees or ornamental shrubs and hedges. Nest a compact sphere of cottony materials, well lined with fine grasses, bark, and rootlets or hair. Eggs 3-6, gray or greenish with brown or purplish markings around larger end; $\frac{3}{4}$ by $\frac{1}{2}$ in. Incubation 12-15 days, by female. 1 annual brood.

Food, insects such as small moths, caterpillars, beetles, flies, and grasshoppers, many of which are caught in air by pursuit through treetops. Cowbirds commonly lay their eggs in yellow warbler nests; yellow warbler often builds a second or even to a sixth nest on top of first.

Entirely useful as a destroyer of insects and one of most interesting and beautiful birds of thickly settled parts of country. Its habit of nesting in parks and ornamental shrubbery and its cheery song make it well known and welcomed by many who never notice other species. Song pitch, 3,475-8,775 c.p.s.

Magnolia Warbler, 657 *Dendroica magnolia*

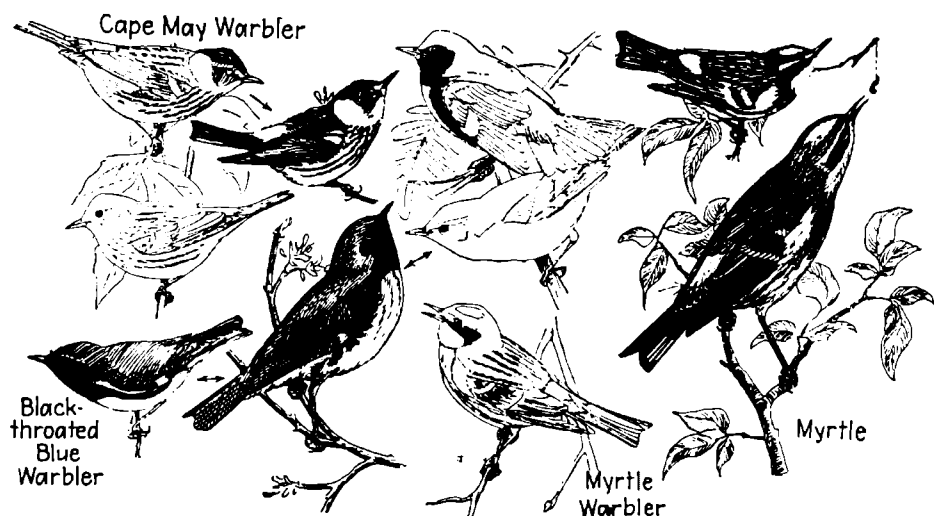
Length to $5\frac{1}{10}$ in. Wingspread to $7\frac{1}{2}$ in. Female smaller than male. Male essentially black and yellow, tail white below with broad black band at tip; from above appears to have large white patches on wings and tail; under parts yellow with many heavy black streaks. In fall, brown above and yellow below, with tail as described above.

Breeds from western Mackenzie and central British Columbia to central Quebec and Newfoundland, south to southern Saskatchewan, Minnesota, New York, Massachusetts, and in mountains south to Virginia. Winters from southern Mexico to Panama and sometimes in Cuba and Bahamas.

Nests usually in June, generally in an evergreen up 1-35 ft. above ground but usually low; of bark, and rootlets fastened together with cobwebs, with soft lining. Eggs 3-6, $\frac{3}{4}$ by $\frac{1}{2}$ in.; white with brown, purple, and lavender spots. Incubation usually by female, though male may assist occasionally. 1 annual brood.

Most active about evergreen trees where they may nest. Young remain in nest about 10 days after hatching. After leaving nest, young and parents are active for only about 4 weeks before beginning southern migration. Food probably exclusively insects, mostly those of treetops.

Most interesting to bird lovers and undoubtedly useful as insect destroyers, with no known habits injurious to man's interests. With cutting down of evergreen timber or with fire damage to such growths, these birds decrease in number.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Compothlypidae. WOOD WARBLERS

Cape May Warbler, 650 *Dendroica tigrina*

Length to 5 $\frac{1}{2}$ in. Wingspread to 8 $\frac{1}{2}$ in. Female smaller than male. Under parts yellow, narrowly striped in black. Cheeks chestnut (unlike any other warbler). Rump yellow. Crown black. Females not brilliantly colored, with breast almost white and with cheeks pale yellow rather than chestnut.

Breeds from southern Mackenzie to Nova Scotia and New Brunswick, south to southern Manitoba, North Dakota, Kansas, New Hampshire, and Maine. Southwest area is visited in fall migration. Winters from Bahamas to West Indies and occasionally in Yucatan. A bird of treetops.

Nests in evergreen woodlands and in sparsely wooded areas in smaller trees. Nest up to 40 ft. above ground, of moss, twigs, or grass bound with spider web, lined with hair and feathers. Eggs 3-4, $\frac{7}{10}$ by $\frac{9}{16}$ in.; grayish or greenish-white spotted with yellow-brown, red-brown, or lilac. Nests in June. Incubation by female with probably 1 annual brood.

Vary greatly in abundance. Usually not unduly suspicious of man and commonly seen some years in suburban trees and shrubbery as well as in thickets and brushy areas. Food probably mostly insects found on woody plants including caterpillars, flea beetles, click beetles, and weevils.

Always interesting to ornithologists and bird lovers and probably wholly useful as insect destroyers. Not sufficiently abundant to play any great role in economy of nature or of man but worthy of every encouragement. Song a highly pitched and thin repeated *seet* given at least 4 times in a series.

Black-throated Blue Warbler, 654 *Dendroica caerulescens*

Length to 5 $\frac{1}{2}$ in., wingspread to 7 $\frac{3}{4}$ in., tail, to 2 $\frac{1}{4}$ in. Female smaller than male. Upper parts bluish-gray, throat and sides black, breast and belly, white. Female and young have a plain olive back, with a faint white line over eye and small white wing spots. Name adequately describes male bird.

Breeds from northern Minnesota to southern Quebec, south to southern Minnesota, mountains of Pennsylvania, and northern Connecticut. Winters from southern Florida and Bahamas to Guatemala and Colombia. In migration is found in North Dakota, Nebraska, Kansas, Colorado, New Mexico, and sometimes in California.

Nests usually in deep woods or at edges of clearings. Nest in a tree or bush, 3-10 ft. above ground, bulky outside and neat within, with a lining of hair, webs, needles, and grasses. Eggs 4-5, grayish, greenish, or brownish-white with brown, lilac, or lavender spots and blotches, $\frac{1}{16}$ by $\frac{1}{2}$ in. Incubation by female, for an unknown length of time.

Food essentially animal matter, such as insects gleaned from trees. Female makes excellent effort to protect her young by hiding them in nest or by pretending injury to herself to attract enemies away from nest. Male may or may not assist in this family function.

Food habits and general behavior are such that it must be considered useful even if it did not win favor by its beautiful appearance and interesting habits. When males begin singing high in trees in migratory area one knows that spring has really arrived. Song pitch, 5,125-6,750 c.p.s.

Myrtle Warbler, 655 *Dendroica coronata*

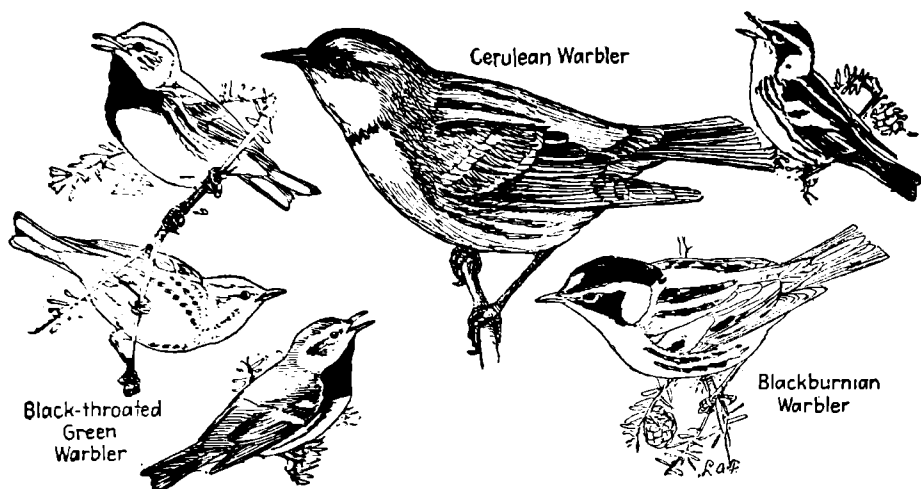
Length to 6 in., wingspread to 9 $\frac{1}{2}$ in., tail to 2 $\frac{3}{4}$ in. Weight to $\frac{1}{2}$ oz. Shows a conspicuous yellow rump. Male in spring, streaked blue-gray above, with yellow spots on crown, sides and rump. Female brown where male is blue, otherwise similar. Adults in winter, brownish-gray above, with yellow rump.

Breeds from northwest Alaska to central Quebec, south to northern British Columbia, northern Minnesota, central Ontario, New Hampshire, Maine, New York, and New England highlands. Winters from Kansas, Ohio Valley, and New Jersey south to Mexico, Panama, and on Pacific Coast, from Oregon to northern Lower California. In Siberia also.

Nests usually in coniferous woodlands, with nest from near ground to 40 ft. up. Nest bulky, of stems, twigs, bark, and grass, bound with cobwebs and lined with hair and feathers. Eggs 3-6, white to creamy, with spots of brown, purple, lavender, or even black; $\frac{5}{16}$ by $\frac{1}{16}$ in. Incubation 12-13 days, by female. 1 annual brood.

While most warblers live almost exclusively on insects, myrtle can exist for a long period on fruits of red cedar, juniper, Virginia creeper, mountain ash, poison ivy, dogwoods, and viburnums. In New England, chief plant food is fruit of bayberry. During spring and summer diet is essentially insects and similar small animals.

Highly useful, as 78% of its food for year is animal matter, largely injurious insects. A pleasure to have bird in abundance, because it comes before most other warblers and seems to resist severe weather better than similar birds.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Compsothlypidae. WOOD WARBLERS

Black-throated Green Warbler, 667 *Dendroica virens*

Length to 5½ in. Wingspread to 8 in. Female smaller than male. Back and crown olive-green, face yellow, throat black. Female with black of throat and under parts less conspicuous. Young and females in autumn without black on throat and upper breast and with under parts yellowish.

Breeds from central Alberta to Quebec and Newfoundland, south to southern Minnesota, southern Wisconsin, New York, and northern New Jersey and in Appalachian highlands on to South Carolina, Georgia, and Alabama. Winters in Mexico, Guatemala, Costa Rica, and Panama. On occasion is found in Greenland, Europe, and Puerto Rico.

Nests among trees like pines, usually from 15-70 ft. above ground; deeply cupped, on horizontal branch, of twigs bound with spider webs and lined with needles, a few feathers, or hair. Eggs 4, ¾ by ½ in.; white or creamy, spotted and speckled with brown, purple, and gray. Nests in June. Incubation 12 days by female. 1 annual brood.

Young remain in nest 8-10 days after being hatched and while there are defended by female. By mid-August, southern migration starts rather leisurely, though late-hatched birds may not start before end of month. Food largely caterpillars, beetles, and bugs of woody plant leaves, particularly leaf rollers and cankerworms.

Useful as a destroyer of enemies of trees and by some is considered one of most useful of woodland birds. Song like a lisping sneeze like zoo-zee-zee-zee-zoo-zee. Beauty of bird makes anyone who sees it an immediate and permanent friend.

Cerulean Warbler, 658 *Dendroica cerulea*

Length to 5 in., including ¾-in. tail and ½-in. bill. Wingspread to 8 in. As name implies, male is blue above; white below and shows a dark or black ring across upper part of breast. Female olive green like many other warblers, but somewhat bluish above and white beneath, with 2 white wing bars and white line over eye, suggestive of some vireos.

Breeds from southeastern Nebraska through southeastern Minnesota, southern Michigan, and southern Ontario to central New York, south through West Virginia to Georgia, central Alabama, Louisiana, and Texas. Winters in Venezuela, eastern Ecuador, Peru, and Central America. Sometimes found in Lower California, Cuba, Bahamas, and even into Manitoba.

Nests usually where there are large trees, commonly 15-90 ft. up near middle of limb. Nest shallow, of vegetable material, such as rootlets, grass, lichens, and sometimes with snakeskins, hair, and feathers. Eggs 3-4, ¾ by ½ in., pale blue- or greenish white or creamy, with reddish spots. Incubation by female.

Food largely insects, known to include caterpillars, beetles, weevils, and similar insects. Flight in somewhat jerking curves, but seen mostly high in treetops. Call a lisping, repeated chip or cheer or zwee, usually ascending at end. Considered a rare bird in East.

Useful as an insect destroyer, but more useful as a feast to the eye of the naturalist. Never sufficiently abundant to do any outstanding service but welcome when it is present.

Blackburnian Warbler, 662 *Dendroica fusca*

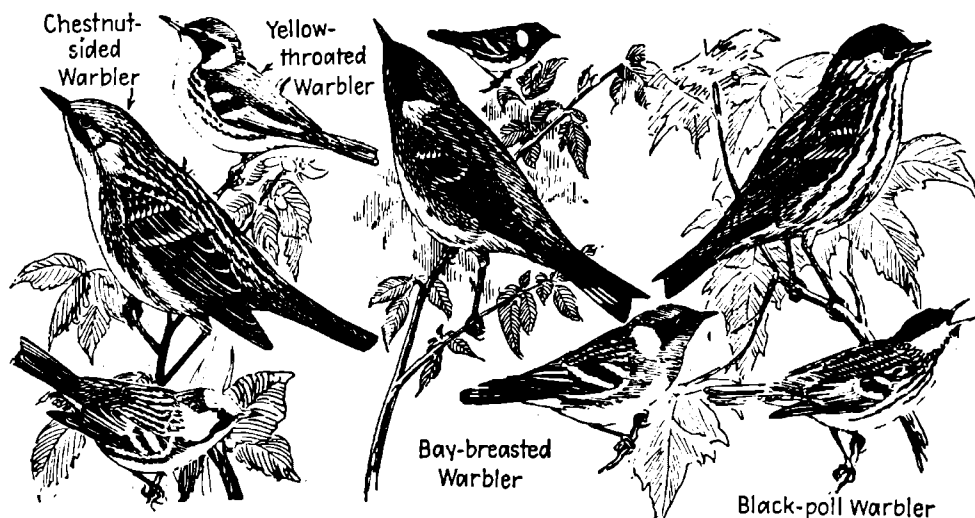
Length to 5½ in. Wingspread to 8½ in. Female smaller than male. Male is bright orange on head and throat region but otherwise mostly black and white; white patches on elbow and tail show conspicuously in flight; paler in autumn. Female dingier in more conspicuous areas.

Breeds from central Manitoba to Cape Breton Island, south to central Minnesota and Connecticut and in Appalachian Highlands to Georgia and South Carolina. Winters from Venezuela and Colombia to Peru and Yucatan. Occasionally in migration in Nebraska, Texas, Montana, New Mexico, and Bahamas.

Nests usually in evergreen tree 6-80 ft. up, usually toward end of limb or in top of tree. Nest highly variable, usually of twigs, with hair, rootlet, or grass lining. Eggs 4, ¾ by ½ in.; blue-green to gray, with brown and lavender spots and blotches. Incubation in June, by female.

An active conspicuous bird of treetops, with a repeated zip call on one pitch but ending with a thin, more highly pitched note. In northern migration, it moves just about time leaves are reaching full size. Food mostly insects of treetops with some caught by sudden dashes into air. Some known to subsist on ivy berries.

Its economic status is that of most warblers in that it destroys great numbers of insect enemies of woody plants and satisfies longings of bird lovers for an active, beautiful, and useful bird.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Compsothlypidae. WOOD WARBLERS

Yellow-throated Warbler (illustrated)
Dendroica dominica

Chestnut-sided Warbler, 659 (described and illustrated)
D. pennsylvanica

Length to $5\frac{1}{4}$ in., wingspread to $8\frac{1}{4}$ in., tail to $2\frac{1}{10}$ in. Female smaller than male. In spring, adults show conspicuous yellow crowns and chestnut sides, differing in this respect from dark-crowned, chestnut-throated bay-breasted warbler. In fall, greenish above, white below, with 2 wing bars and white eye ring.

Breeds from central Saskatchewan to Newfoundland, south to eastern Nebraska, northern New Jersey and, in Alleghenies, south into Tennessee and South Carolina. Winters from Guatemala to Panama. Occasionally in California, Mexico, Greenland, Florida, and Bahamas.

Nests in shrubbery, near pastures, at margins of woodlands, usually 1-6 ft. above ground. Nest neat, compact, of grasses, weeds, and bark, cemented with spider webs, and lined with plant fibers. Eggs 4-5, white or creamy with brown or lavender spots, $\frac{3}{8}$ by $\frac{1}{2}$ in. Incubation for 10-11 days. 1 annual brood, reared by both sexes.

Excellent insect catcher; food caught by gleaning or by short dashes into air. Known to eat gypsy moths, tent caterpillars, brown-tail moths, plant lice, leaf hoppers, ants, and borers. One of best caterpillar destroyers. Young in nest 9 days, fed little besides insects. Adults may eat some seeds and wild fruit in fall.

An unusually beautiful but rather shy bird, probably more often heard than seen and certainly more often heard than identified. Two adults attending young in nest make a memorable picture. Song pitch, 3,100-8,775 c.p.s.

Bay-breasted Warbler, 660
Dendroica castanea

Length to 6 in., wingspread to $9\frac{1}{4}$ in., tail to $2\frac{3}{4}$ in. Female smaller than male. Dark chestnut throat, upper breast, and sides; pale light brown spot on side of neck. Lacks white throat and yellow crown of chestnut-sided warbler.

Breeds from east central Alberta to Newfoundland, south to southern Manitoba, Adirondacks in New York, and mountains of New Hampshire. Winters in Panama and Colombia. Occasionally found in Greenland, Texas, Montana, and South Dakota.

Breeds in mixed forests or coniferous stands. Nest in a conifer, 3-20 ft. up, of fine twigs and moss, with rootlet, hair, or needle lining. Eggs 3-4; pale blue-green or greenish-gray with brown or lilac spots, $\frac{3}{4}$ by $\frac{9}{16}$ in. Incubation by female. 1 brood yearly.

Food habits little understood but known to include destruction of locusts, caterpillars, ants, beetles, and leaf hoppers, which are fed to young. Spends most of its time in dense foliage of trees and is not so easily seen as some other warblers.

Useful as insect destroyer, like other warblers. In autumn, abundance may not be suspected as they appear olive green with 2 white wing bars and a rather dirty brownish-yellow beneath. In fall, yellow under tail, while black-poll warbler is white there and has more distinct streaks.

Blackpoll Warbler, 661
Dendroica striata

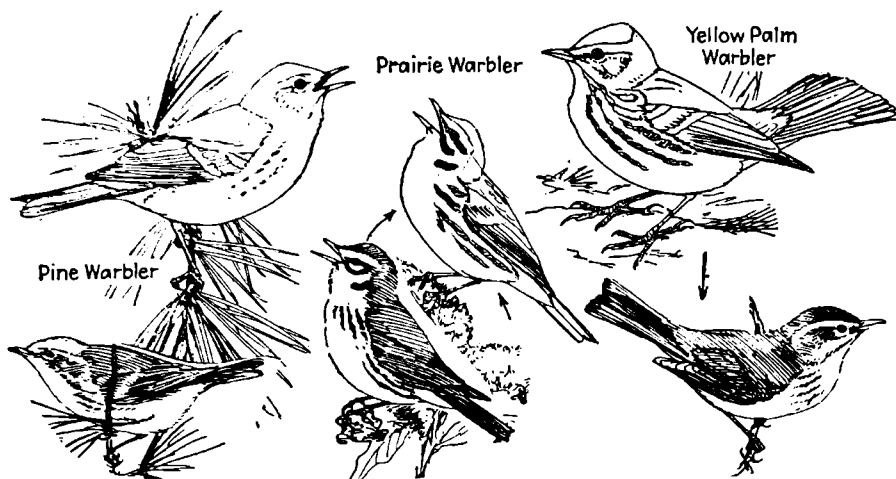
Length to $5\frac{3}{4}$ in., wingspread to $9\frac{3}{4}$ in., tail to $2\frac{1}{4}$ in. Female smaller than male. Male in spring with solid black cap instead of streaked cap of black and white warbler. Female in spring less heavily streaked, greenish above, pale below. Adults in fall olive above and dingy streaked yellow below, with 2 white wing bars.

Breeds from tree limit in northwestern Alaska to Newfoundland, south to northern British Columbia and highlands of New York and New England. Winters from Guiana and Venezuela to Brazil, migrating through Bahamas and West Indies. Occasionally in Mexico, Chile, and Ecuador.

Breeds among coniferous forests or swampy groves. Nest low in evergreen or on ground, of mosses, lichens, and feathers. Eggs 4-5, creamy-gray, speckled and spotted with reddish-brown, purplish-gray, or lilac, $\frac{3}{4}$ by $\frac{9}{16}$ in. Incubation data not available.

Food essentially insects gleaned from trees, including cankerworms, webworms, plant lice, locusts, small grasshoppers, beetles, ants, and gnats. Call sounds like noise made by cutting glass; not audible to many persons. Pitched, 8,050-10,225 c.p.s. In migration, probably fly several hundred miles across Caribbean to reach land.

Probably of considerable importance because of great numbers which migrate north at time of year when new growth of woody plants is most susceptible to attack from insects that provide these birds with their food. Always interesting to those who care for birds in their season.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Comptothlypidae. WOOD WARBLERS

Pine Warbler, 671

Dendroica pinus

Length to $5\frac{3}{4}$ in. Wingspread to $9\frac{3}{4}$ in. Female smaller than male. Olive above with bright yellow breast and 2 white wing bars. Yellow brightest in throat region. Tail with white spots. Faint streaks on breast. Female less brilliantly colored. In fall, olive above, with 2 white wing bars but not bright yellow below.

2 subspecies. Breeds from northern Manitoba to New Brunswick, south to east central Texas and Gulf States, with Florida subspecies confined to Florida. Winters from southern Illinois to Massachusetts and south into Mexico and Florida.

Nests April-May, usually in evergreen woodland, on long branch, usually 20-50 ft. above ground, often in a fork; of weeds, bark, and needles, twisted and fastened with spider web and lined with fine material. Eggs 3-5, $\frac{3}{4}$ by $\frac{5}{16}$ in., white or greenish-white with brown, black, or purple spots and blotches. Incubation by female. 1-3 annual broods.

Adult birds excellent parents and breeding season is unusually long with males fighting for mates vigorously. Food essentially insects of evergreens, though in fall it may eat grasshoppers and other ground insects. Call much like that of a musical, irregular chipping sparrow.

Undoubtedly, bird is useful as a destroyer of insect enemies of evergreen forest trees and to some extent of plants of forest floor and near-by ground.

Prairie Warbler, 673

Dendroica discolor

Length to $5\frac{1}{2}$ in. Wingspread to $7\frac{1}{4}$ in. Female smaller than male. Male with chestnut spots on back and with yellow under parts, with streaks of black only on sides. Black on face in spots through eye and under eye. Female almost identical with male but with chestnut spots fainter.

Breeds from eastern Nebraska to Pennsylvania and New York, south through Arkansas, northern Mississippi, central Georgia, and Bahamas, with a southern subspecies, Florida prairie warbler, breeding in Florida. Winters from central Florida, Bahamas, and West Indies to islands off coast of Central America.

Nests in brushy low-treed country, where it is relatively dry or even in rather barren pastures. Nest 1-12 ft. above ground, hidden, of plant stems, bark, and leaves, with finer lining and cobweb binding. Eggs 3-5, $\frac{3}{10}$ by $\frac{1}{2}$ in.; white to greenish with spots of purple or brown. Incubation 14 days, by female. 1 annual brood.

While name implies that it lives in open prairie country, this is far from true. Not conspicuous but has an interesting zee-zee oft-repeated song which rises to higher notes. Both parents care for young, and by end of July when young are off nest, southern journey may begin. Most birds have left north by September.

Undoubtedly useful as insect destroyers. Stomach examinations show that the food is 100% animal matter, with bugs constituting about half, followed by beetles, moth larvae and adults, and other groups in a minor capacity.

Yellow Palm Warbler, 672a

Dendroica palmarum

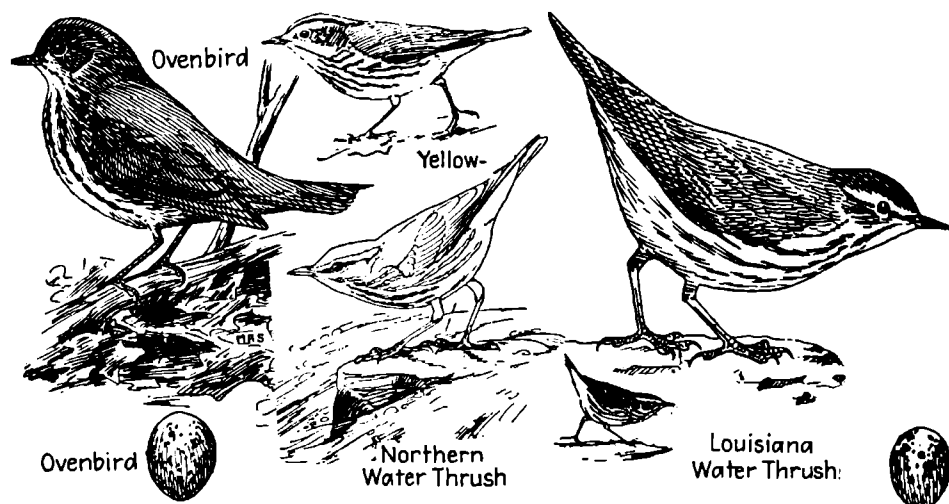
Length to $5\frac{1}{2}$ in. Wingspread to $8\frac{3}{4}$ in. Female smaller than male. Essentially a dull yellow color with a chestnut-reddish crown that is most brilliant in spring and summer plumage. Yellow palm warbler more brilliantly colored and larger than western palm warbler, which is less yellow beneath at all ages.

Western palm warbler breeds from southern Mackenzie and northern Manitoba to northern Minnesota. Winters from southern Florida and Bahamas to Greater Antilles and Yucatan. Yellow palm warbler breeds from Ontario to Newfoundland and south to southern Nova Scotia and Maine. Winters from Louisiana to Florida, or on occasion in West Virginia, Pennsylvania, and Massachusetts.

Yellow palm warbler nests in open shrubby fields and pastures on or near ground. Nest of grasses with abundant lining of hair and feathers. Eggs 4-5, $\frac{3}{4}$ by $\frac{1}{2}$ in.; buff or cream-white spotted with brown and lilac, often in a ring around larger end. Nests in June. Incubation probably by female, and probably 1 annual brood.

Easily identified by conspicuous tendency to wag tail violently like water thrush or spotted sandpiper. Frequently appears in fair-sized flocks. It works most of time close to ground, unlike many of its relatives. Song a weak repeated lisping *thi*. Food almost entirely insects with some seeds mixed in.

Useful as a destroyer of insects that might be injurious to plants in region where it lives, which is usually relatively near lands used by man.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Compsothlypidae. WOOD WARBLERS

Ovenbird, 674

Seiurus aurocapillus

Length to $6\frac{1}{2}$ in., wingspread to $10\frac{3}{4}$ in., tail to $2\frac{1}{2}$ in. Female smaller than male. Appears like small brown thrush, striped beneath rather than spotted, and with a light orange patch on top of head. Ovenbird walks, while thrushes usually hop. Sexes alike in appearance.

Breeds from southwestern Mackenzie to Newfoundland, south to southern Alberta, Colorado, Arkansas, Georgia, and North Carolina. Winters from northern Florida and Louisiana coast to Mexico, Bahamas, and Colombia. Sometimes found in California in migration.

Nests usually in hardwood forest, on ground, building a roofed house under a leaf pile or in a grass tussock. Nest lined with hair, needles, or fine grasses. Eggs 3-6, white to creamy or pinkish, variously spotted and blotched with brown and lilac; $\frac{9}{10}$ by $\frac{7}{10}$ in. Incubation 12 days, chiefly by female. 1 annual brood.

Food largely insects of forest floor, slugs, snails, earthworms, spiders, myriapods, and other small animals. Known to destroy gypsy moths, click beetles, grasshoppers, butterflies, weevils, and many other insects. Song pitch, 3,300-5,850 c.p.s.; median, 4,000 c.p.s.

Repeated *teacher* call of ovenbird is heard more often than bird is seen and bird is seen many more times than nest is found, but each provides a worthwhile experience for an amateur naturalist. As destroyer of insects it undoubtedly serves man and justifies protection it receives.

Northern Water Thrush, 675

Seiurus noveboracensis

Length to $6\frac{1}{4}$ in., wingspread to 10 in., tail to $2\frac{3}{8}$ in. Female smaller than male. Slightly smaller than Louisiana water thrush, which has white instead of yellow line over eye and lacks yellowness of streaked under parts. Both are brown-backed birds which teeter nervously, almost constantly.

2 subspecies, northern and Grinnell's. Northern breeds from northern Ontario to Quebec, south to Pennsylvania, West Virginia, and northern New England. Winters from Mexico to Colombia and British Guiana. Grinnell's extends range westward to Pacific. Louisiana water thrush has a more southern range than Northern (see next column).

Nests in cool wet swampy woods or bogs, or along small boggy streams. Nest a cavity under vegetation or under a large root, usually lined with finer vegetation. Eggs 4-5, pinkish or creamy white with spots, streaks, and blotches of brown or lavender, $\frac{7}{8}$ by $\frac{7}{10}$ in. Incubation 14 days, by female. 1 annual brood.

Food essentially aquatic insects and crustaceans picked up at edges of streams it haunts. Wild songs of both Northern and Louisiana water thrushes are in keeping with usual dashing streams where they may live. Northern water thrush ends its song with a repeated *chew* not given by possibly louder Louisiana subspecies.

Birds and songs are part of land of bogs and little glens; to those familiar with them, first sight of birds mean that spring flowers will soon be at their best. Somehow seem to have sense of humor as they teeter on a rock in a stream, daring one to follow. Song pitch, (Northern) 2,000-3,850, (Louisiana) 2,475-6,600 c.p.s.

Louisiana Water Thrush, 676

Seiurus motacilla

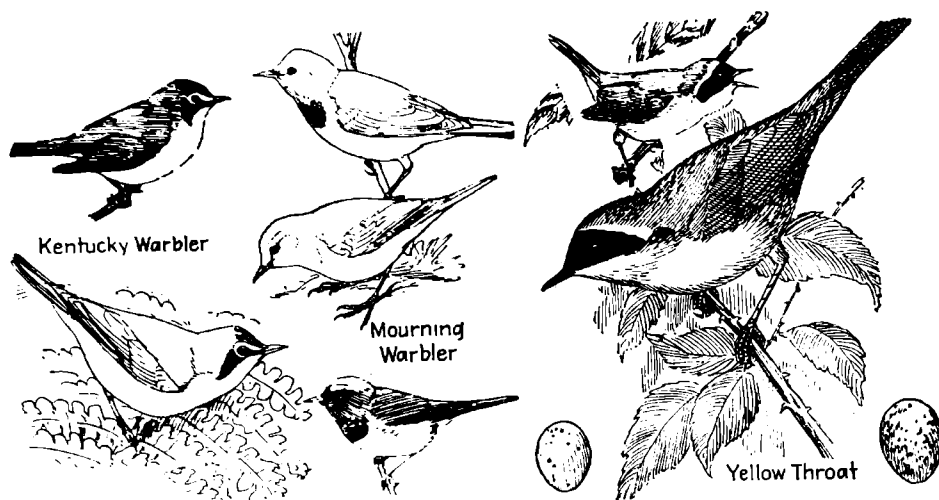
Length to $6\frac{2}{5}$ in. Wingspread to $10\frac{3}{4}$ in. Female smaller than male. Differs from Northern water thrush in unstreaked throat, in being less yellow beneath and without yellow line over eye. In this species line over eye is pure white. General color olive brown with brown streaks on lighter under parts.

Breeds from eastern Nebraska and southeastern Minnesota to southern Ontario and New England to Texas, southern Alabama, northern Georgia, and central South Carolina. Winters from northern Mexico to Colombia, Greater Antilles, Antigua, and Bahamas. Accidental in California.

Nests in a crevice in a wooded rocky bank near a small active stream. Nest lined with moss and dry leaves but surrounded with a bulky mass of leaves. Eggs 4-7, $\frac{9}{10}$ by $\frac{7}{10}$ in.; glossy and polished white with variable markings of brown and lilac-gray. Nests May-June. Incubation 12-14 days, mostly by female.

A bird of active gorges much like water ouzel of West in its habits and haunts. It runs about at edge of rapid water but does not submerge in it as does water ouzel. Its song is stimulating, loud, sweet, vigorous, and always popular and awaited by bird lovers.

Food probably chiefly insects and other small animals gleaned from an area of little economic importance. From a dollar and cents standpoint, bird probably does little good but from an emotional standpoint it ranks high with bird lovers.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family *Comptothlypidae*. WOOD WARBLERS

Kentucky Warbler, 677

Oporornis formosus

Length to 5½ in. Wingspread to 9¼ in. Female smaller than male. Conspicuously contrasting plain olive above and bright yellow beneath. Black streaks from eye to side of yellow throat, dark to black forehead, and a yellow hook or streak from bill to over and back of eye. Olive where Canada warbler is gray.

Breeds from southeastern Nebraska to Hudson Valley, south to eastern Texas, northern Georgia, southern Alabama, and Louisiana. Winters in Mexico from Tabasco, Campeche, and Chiapas through Central America to Colombia and accidentally in Cuba, Vermont, and Michigan.

Nests in open, in under growth at edge of woodlands, or in brushy areas near marshes, on or near ground in thick growth. Nest bulky, of grasses, leaves, and stems, with lining of hairs, roots, or both. Eggs 4-6, ¾ by ¾ in.; glossy white with brown spots, speckles, and blotches. Incubation by female. 2 broods, sometimes.

Commonly feeds on ground but sings its loud, repeated *turtle turtle* from treetops. Active but shy and usually suspicious. Male sings almost continually in height of breeding season. Young leave nest in about 8 days and after nesting is over birds are quiet and secretive.

Food largely insects including grasshoppers, plant lice, larvae of moths, beetles, and other insects. These are gleaned mostly from areas near ground and include ants not common in environment of many warblers.

Mourning Warbler, 679

Oporornis philadelphia

Length to 5¾ in. Wingspread to 8½ in. Female smaller than male. Olive above and yellow beneath with a gray hood encircling head and neck and in male with a black bib on upper breast where gray of head and yellow of breast meet. No eye ring except sometimes an obscure one in females and immature birds.

Breeds from east central Alberta and central Saskatchewan to Nova Scotia and Newfoundland, south to central Minnesota, Michigan, Ohio, and in highlands of New York, Massachusetts, Pennsylvania, and West Virginia. Winters from Nicaragua to Costa Rica, Venezuela, Colombia, and Ecuador. Flies across Gulf of Mexico in one flight.

Nests in brier patches, weeds, and bushes in cutover lands and clearings. Nest near ground in a clump of weeds, of weed stalks mixed with leaves and lined with roots, hairs, and grass. Eggs 4-6, ¾ by ¾ in.; glossy white with spots and speckles of brown, lilac, and gray. Incubation chiefly or wholly by female. 1 annual brood.

Not a common warbler and usually so secretive that it is not seen. Family remains near nest until molt is over after family is independent; then starts on southern migration, northern part of range being free of birds by end of September.

Little is known of economic importance of species but beetles and spiders have been found in stomachs of some birds. Probably useful, but aside from its interest to ornithologists plays no important role in the economics of its territory.

Maryland Yellowthroat, 681

Geothlypis trichas

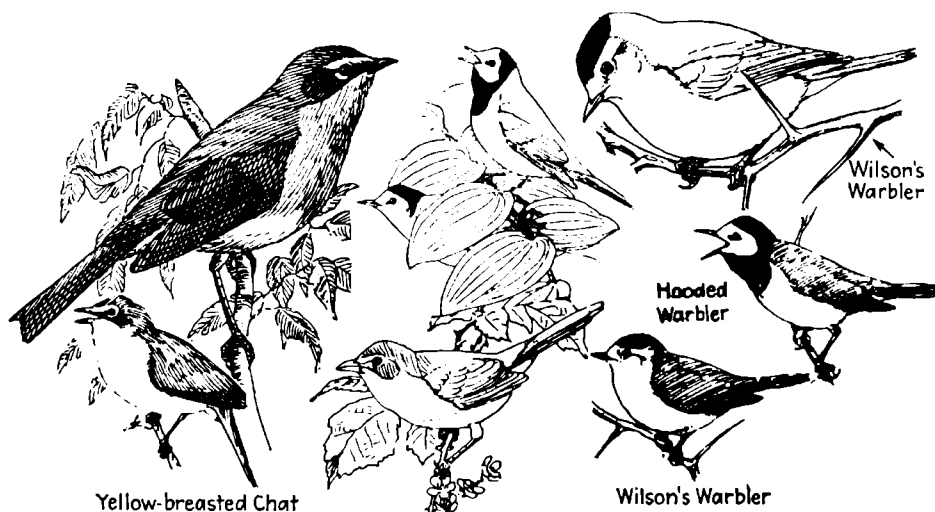
Length to 5¼ in., wingspread to 7½ in., tail to 2 in. Male olive above, yellow beneath, and with conspicuous black mask across face and side of head. Female and young plain olive, with yellow throat and breast but no black mask, and with belly whitish instead of yellow as in yellow warbler.

6 subspecies include Northern, Maryland, Florida, Western, Salt Marsh, the Tule yellowthroats. Northern breeds from Newfoundland to Quebec, south to Pennsylvania. Winters in Mexico, Bahamas, and Costa Rica. Other subspecies extend range over most of United States.

Nests in thickets, in cattail bogs, and in meadows and hedgerows. Nest of dried leaves and grasses lined with grasses, roots, and some hairs; bulky, deep, but well concealed for breeding season. Eggs 3-5, white with brown or purple spots and streaks particularly at large end, ¾ by ¾ in. Incubation 12 days. 2 annual broods.

Food essentially insects, particularly small caterpillars which do so much damage to crops, also ants, aphids, grasshoppers, crickets, leaf hoppers, spiders, and other small creatures. The *witchity-witchity* call varies slightly over the country but is easily recognized.

One of most useful species and fortunately is present over its range in considerable numbers. Activity displayed by a yellowthroat on a hot summer day is worth observing. It sings as it works far into the summer.



PHYLUM CHORDATA. CLASS AVES
Order Passeriformes. Family Comptolypidae. WOOD WARBLERS

Yellow-breasted Chat, 683
Icteria virens

Length to $7\frac{1}{2}$ in., wingspread to 10 in., tail to $3\frac{1}{4}$ in. Plain olive above with bright yellow throat, white belly, white around eye and across face in a narrow line. Tail long and conspicuous. Sexes colored alike, though female may be duller in color.

2 subspecies include Yellow-breasted and Long-tailed chats. Yellow-breasted breeds from Minnesota to Ontario, south to Texas and southern Florida. Winters in Mexico, Central America, Yucatan, and Costa Rica. Occasional in Saskatchewan, New Hampshire, and Maine. Long-tailed chat extends range west to Pacific.

Nests chiefly in thickets, near pastures, or in berry patches and vine tangles. Nest 1-5 ft. above ground, coarse and bulky, of leaves and grasses with finer lining. Eggs 3-5, pinkish or greenish-white, glossy, with reddish-brown or lavender spots, $\frac{3}{10}$ by $\frac{3}{16}$ in. Incubation 15 days, by female. 1 annual brood.

Food essentially insects, of almost all kinds to be found, but also elderberries, wild strawberries, wild grapes, blackberries, and similar fruits. Comical repertoire of songs makes it a clown of bird world because variety and volume are almost unbelievable. Song pitch, 1,275-4,400 c.p.s.

Chat is not known to harm man's interests but man seems to scare it from its haunts without much difficulty. Worth knowing better. Anyone who can listen to its chatter and not grin and wonder what it is all about must be wholly lacking in a sense of humor.

Hooded Warbler, 684
Wilsonia citrina

Length to $5\frac{3}{4}$ in. Wingspread to $8\frac{1}{2}$ in. Female smaller than male. Male has a black hood which encircles completely head and neck; with yellow face and forehead, yellow under parts, and an olive back. Females and young bright yellow on under parts and forehead and plain olive on upper parts; bill black, white on tail.

Breeds from southeastern Nebraska to lower Connecticut River Valley and south through Louisiana, Alabama, Georgia, and northern Florida. Winters from Vera Cruz and Yucatan to Panama with records from Bahamas, Cuba, and Jamaica.

Nests in brushlands or dense undergrowth in woodlands, wooded marshlands, or hillsides. Nest 1-5 ft. above ground in a bush or small tree, of leaves, bark, weed stems with lining of plant down, moss, hairs, grasses, and pine needles. Eggs 3-5, $\frac{3}{16}$ by $\frac{3}{12}$ in.; white or creamy with brown spots. Incubation by both birds. 1-2 annual broods.

Normally a shy bird staying close to its home thickets but sometimes individuals are otherwise. Opens and closes tail like a fan while singing in flight. Male will defend territory rather effectively at times. Southern migration may begin as early as August unless a second brood is being raised.

Food consists of insects, many taken on wing and including grasshoppers, crickets, caterpillars, and plant lice. Probably indicates that it is a useful species. Its song is a clear sweet *weeta weeta*, dropping at end and very musical.

Wilson's Warbler, 685
Wilsonia pusilla

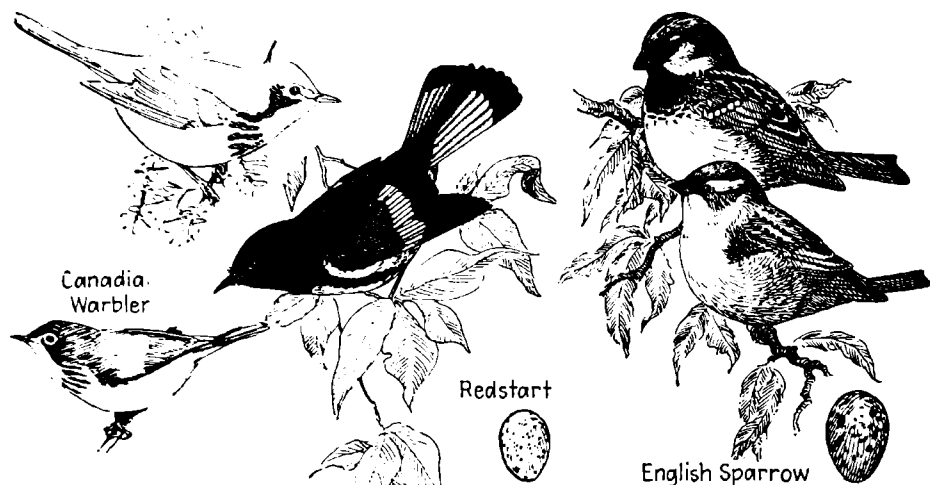
Length to $5\frac{1}{10}$ in. Wingspread to 7 in. Female smaller than male. Male pale olive above, light yellow beneath, with a small round black cap. Females and young may or may not show traces of cap. Female shows white spots on tail, thus differing from yellow of yellow warbler. No streaks or bars.

Breeds from central and northwestern Mackenzie to Newfoundland, south to southern Saskatchewan, New Hampshire, Maine, and Nova Scotia. Winters in eastern Central America, north to Mexico, south to Guatemala and Costa Rica. Migrates chiefly along Appalachian Highlands, crossing Gulf of Mexico in migration.

Nests in swampy brushlands, on ground, or even in a depression among bushes; of grasses, with finer grass and hair lining. Eggs 4, $\frac{2}{9}$ by $\frac{1}{2}$ in.; white with spots of reddish-brown or lilac-gray particularly around larger end. Nests in June. Incubation by female. 1 annual brood.

Quick energetic bird, often acting like a flycatcher in procuring its insect food on wing, in which cases bill may sometimes be heard to snap. It also twitches tail in a rotary fashion. Southern migration begins in August and most birds have left northern part of range by end of September.

Since food is largely insects, it is probably a useful species though no exhaustive study has been carried on. Its song is simple, drops at the end, and sounds a bit like a repeated *chee chee*. Distinctive black cap provides an excellent field mark for its recognition.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes

Family Compothlypidae

Canada Warbler, 686

Viloria canadensis

Length to $5\frac{3}{4}$ in. Female slightly smaller than male. Male with upper parts plain gray and lower parts bright yellow but with a necklace of short blackish stripes across upper breast. Female without necklace. No white on wings or tail of either sex, thus differing from similar species.

Breeds from southern Alberta to Newfoundland, south to central Minnesota, central New York and Connecticut, and in highlands to Georgia and Tennessee. Winters in Ecuador and Peru and to some extent in Guatemala and Costa Rica and in migration in eastern Mexico.

Nests on or near the ground in wooded or swampy wooded areas. Nest well concealed, of dried leaves, grass, moss, and bark, with lining of rootlets and hairs. Eggs 4-5, $\frac{3}{4}$ by $\frac{1}{2}$ in.; white or brownish-white with speckles of reddish-brown and lilac chiefly around larger end. Nests in June. No data on incubation. 1 annual brood.

Active bird in migration, giving a rather loud musical song that has been described as a repeated *rup-it-chee* ending in a *rup-it-chit-it-lit*. Catches food of insects on wing like a flycatcher, gleanes it from finer vegetation in which it lives, or may even gather it from ground.

Food habits so far as known would indicate that it is a useful species engaged in keeping in control insects that might otherwise injure plants, even though plants thus protected are not ordinarily recognized as of agricultural importance.

Redstart, 687

Setophaga ruticilla

Length to $5\frac{3}{4}$ in., wing to $2\frac{1}{2}$ in., tail to $2\frac{1}{2}$ in. Female smaller than male. Male black with orange patches on wings, tail, and sides of breast; belly white. Female olive, with lemon yellow patches in place of orange. Young much like female, and young breeding male may still lack characteristic salmon, orange, and black coloration.

Breeds from northern British Columbia to Newfoundland south to Oregon, northern Utah, Oklahoma, Arkansas, southern Alabama, northern Georgia, and North Carolina. Winters in West Indies and from central Mexico and southern Lower California to Ecuador and British Guiana. Occasionally in California, Arizona, and northern Ungava.

Nests in woodlands or pastures. Nest in upright crotch, 3-35 ft. above ground, compactly woven, thin-walled, and beautifully lined with fibers or hair fastened together with webs. Eggs 3-5, creamy or grayish sprinkled with lilac, purple, or brown, $\frac{7}{10}$ by $\frac{1}{2}$ in. Incubation by female, 12-14 days. 1 annual brood.

Food includes caterpillars of many sorts as well as moths, gnats, bugs, beetles, grasshoppers, flies, and other insects probably including useful as well as injurious forms. Male active. Song (pitched at 4,400-7,300 c.p.s.) means summer to most who know it. In display, salmon and black coupled with excessive activity makes bird conspicuous.

Unquestionably, redstarts are useful. They are popular with all who know them either from their nest, their song, or their coloration and activities. They deserve protection they get from the law and should be afforded more protection from tree-climbing cats.

Family Ploceidae

English Sparrow, 688.2

Passer domesticus

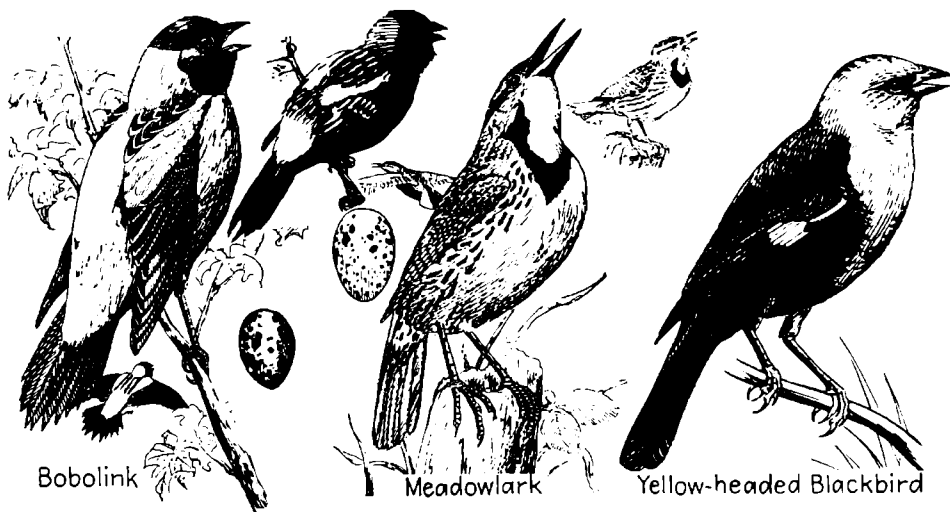
Length to $6\frac{1}{2}$ in., wingspread to $9\frac{1}{2}$ in., tail to $2\frac{1}{2}$ in. Weight averages 1 oz. Temperature, 107-109°F. Male needs no description. Female easily confused with other sparrows; chiefly olive brown with chestnut-streaked back. Bill of adult male, black, of young male and of female brown.

Ranges and breeds throughout Europe and British Isles, except in Italy and on east to Siberia. Introduced into America at Brooklyn in 1850, and later at Quebec and Halifax. Now firmly established wherever man lives in numbers. Allied races in southern Asia, Asia Minor, and Africa. Defended home territory, several feet.

Nest a clumsy bulky mass of grass, trash, and feathers, tucked into a bird-house, under a roof, in a woodpecker hole, or even in a tree. Eggs 4-9, grayish spotted with reddish-brown, or dark brown and gray, $\frac{9}{10}$ by $\frac{3}{4}$ in. Incubation by female, 10-16 days. Annual broods, 3 or more. Nests April-September.

Food, garbage, manure, insects, grain, fruits, young garden plants and almost anything possibly edible. Quarrelsome, driving more useful species away, particularly from desirable nesting sites. Acr in unison to eliminate rival individuals or species. Known to carry some diseases. Extremely hardy under all circumstances.

A harmful bird if any species is, yet one of commonest and least bothered. Men try to destroy useful hawks and owls but leave more destructive English sparrows unharmed. Numbers decreasing somewhat. Flight speed, 17 m.p.h. Hearing range, 675-11,500 c.p.s.



Bobolink

Meadowlark

Yellow-headed Blackbird

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Icteridae. MEADOW LARKS, BLACKBIRDS

Bobolink, 494 *Dolichonyx oryzivorus*

Length to 8 in., wingspread to 12½ in., tail to 3½ in., bill to ½ in. Weight to 1½ oz. Female smaller than male. Male in spring black below and with conspicuous white markings above. Female and autumn birds like large yellowish-brown sparrows, with darker stripings on upper parts.

Breeds from southeastern British Columbia to Cape Breton Island, south to northeastern California, West Virginia, Pennsylvania, and New Jersey. Winters in South America to southern Brazil, Bolivia, Peru, northern Argentina, and Paraguay. Migrates through West Indies and along east coast of Central America.

Nests in meadows and fields. Nest on ground, well-built, concealed by grass tuft, made of grasses, lined with finer materials. Eggs 4-7, highly variable, grayish, bluish, or brownish, spotted or blotched with brownish-red or lavender, 1½ by ¾ in.; weight ¼ oz. Incubation 10 days, by female. 1 annual brood.

Food in breeding ground, May-June, from 70% to over 90% insects; 65% in August, 90% in September. When in South, in Georgia and Alabama, chief food is rice. Grain taken in North is negligible. Eats enormous quantities of weed seeds on its migration. Its sparkling song, when in breeding territory, is delightful.

No doubt that in North bobolink is an extremely valuable bird but in rice fields it is otherwise. In 1912, over 700,000 bobolinks were killed and sold for markets from South Carolina alone. They are now protected by law but their numbers were seriously reduced by marketing activities. Hunters received 2 cents apiece. Song pitch to 6,950 c.p.s.

Meadowlark, 501 *Sturnella magna*

Length to 11 in., wingspread to 17 in., tail to 3½ in., bill to 1½ in. Weight to 5 oz. Temperature, 107°F. Female much smaller than male. Chunky in appearance with rather stubby tail, with white outer tail feathers, with a black bib and yellow breast and throat. General color light brown, flecked with dark.

3 subspecies: Eastern, Southern (smaller), and Rio Grande meadow larks. Eastern breeds from Minnesota to New Brunswick, south to northern Texas and North Carolina. Winters from Ohio Valley and Maine, south to Gulf of Mexico. Western species *S. neglecta* extends to Pacific Coast. From California Pleistocene.

Nests in open fields. Nest of grasses, on ground, usually under a roof of growing grasses, well lined with finer material; sometimes with 1-2 tunnel entrances. Eggs 3-7, whitish spotted with brown, purple, and lavender, weight ½ oz.; 1½ by ¾ in. Incubation 15-17 days, by both sexes. 1-2 annual broods. Defended home territory, several acres.

Food in summer, 99% insects, most of them injurious to crops among which birds live. In fall, food is largely weed seeds. Insects constitute 39% of food in December, 24% in January, 73% in March. Particularly destructive to cutworms. Call of Eastern meadow lark, a series of clear whistles; of Western, a loud bubbling series. Speed, 40 m.p.h.

With hay at \$10 a ton, saves \$25 a year in average township by destroying insects which destroy hay. Worth more than money for its cheerful song. Song pitch, (Eastern) 3,150-6,025 c.p.s., (Western) 1,475-3,475 c.p.s. State bird of Kansas, Montana, Nebraska, North Dakota, South Dakota, Oregon, and Wyoming.

Yellow-headed Blackbird, 497 *Xanthocephalus xanthocephalus*

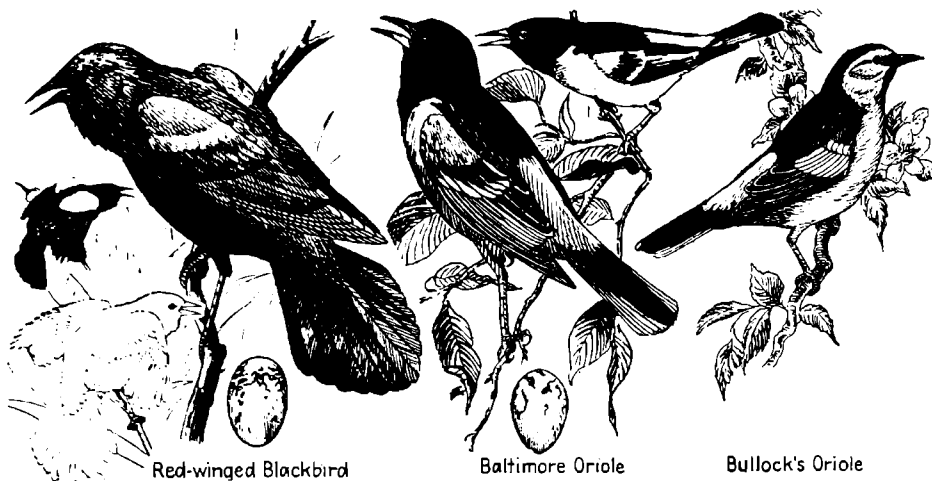
Length to 11 in., wing to 5¾ in., tail to 4½ in. Female slightly smaller than male. Male in summer with head, neck, and pointed throat area yellow or orange, with rest black except for white wing patches. In winter, yellow is obscured by dusky. Female dark brown, without wing patch, with dull yellowish throat and forebreast.

Breeds from southern British Columbia to Wisconsin, Indiana, Texas, and southern California. Winters from southern California and Texas south into Mexico. Northern migration ends in late April. Accidentally in Greenland, Ontario, Cuba, Florida, and south Carolina.

Male selects site, displays before female, and drives out other males. Nest hung in cattails or tules, usually above water, like a thick-walled basket of plant materials. Eggs usually 4, gray or greenish-white speckled with brown. Young helpless when hatched, but out of nest though still helped by parents in mid-July. Young brown-headed.

Food 33% animal matter and 66% vegetal. Grasshoppers important among insects eaten. Does not attack garden produce. Congregates in flocks in marshes, with redwings but usually in separate area. May form huge flocks when families unite in late summer.

Because of fact that 33% of total food eaten may be waste grain, conceivable that bird might be considered as undesirable in spite of good done in destroying insects. Always appealing to naturalist and is conspicuous even from window of a speeding train. Song pitch median, 2,000 c.p.s.



Red-winged Blackbird

Baltimore Oriole

Bullock's Oriole

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Icteridae. MEADOW LARKS, BLACKBIRDS

Red-winged Blackbird, 498

Agelaius phoeniceus

Length to 9½ in., wingspread to 14½ in., tail 5½ in. Weight to 3 oz. Female smaller than male. Breeding male black with scarlet "shoulders" bordered with white or buff, this becoming rusty in winter. Female with head, back, and under parts brownish-black with light streaks. Young males rusty, with orange in place of red.

14 subspecies include Eastern, Florida, Gulf Coast, Northwestern, Nevada, Rio Grande, and Sonora redwings. Eastern breeds from Ontario to Nova Scotia south to Gulf States, wintering south of Ohio and Delaware valleys. Other subspecies extend range over the rest of Canada, United States and Mexico. From Florida Pleistocene.

Male selects site and defends it against other males. Female accepts site and male. Nest built in marshland by weaving plant materials to form basket above water level; lining, soft. Eggs 3-5, pale blue streaked with black or purple, 1 by 1½ in. Incubation 10-14 days, by female. 1-2 annual broods. Temperature, 100.8-104.6°F.

Food in breeding season largely insects, birds sometimes flying ½ mile to get cankerworms for young where such pests are abundant. In fall, may join bobolinks in raiding rice fields. Fly in great flocks in "ranks." Among first birds to come north in spring. Speed, 25 m.p.h.

While it may be pest at times in certain areas, good done generally far outweighs bad. Enjoys certain protection from the law. While it lives much of time in marshes, it ranges for food over adjacent territory. *Konkeree* call one of best known signs of spring. Song pitch, 1,450-4,375 c.p.s.

Baltimore Oriole, 507

Icterus galbula

Length to 8½ in., wingspread to 12½ in., tail to 3½ in. Weight of female 1½ oz. Female smaller than male. Male black and brilliant orange. Female and young dull yellow beneath, olive yellow above, with 2 light wing bars; less green than female orchard oriole. Orchard oriole male chestnut where Baltimore oriole male is orange.

Breeds from central Alberta to Nova Scotia, south through eastern Montana, Wyoming, and Colorado to southern Texas and east through Louisiana, northern Alabama, and northern Georgia. Winters in southern Mexico, on through Central America to Colombia. Sometimes found in Cuba and north to Hudson Bay.

Nests in tops of fine-twigged trees like elms, hanging nest near branch tips. Nest beautifully woven bag of plant materials, string, and hair; closes with weight. Eggs 4-6, grayish-white with streaks, blotches, and dots of brown, black, and lavender; 1 by 2/3 in. Incubation 14 days, by female. 1 annual brood. Temperature, 107°F.

Food essentially insects gleaned from treetops. Animal matter 83%, 34% of total being caterpillars. Caterpillars include those of gypsy moth, cankerworm, bagworms, and brown-tail moth. Plant food includes grapes; in migration, orioles may hurt market value of bunches of grapes by puncturing them. Speed, 26 m.p.h.

On the whole, a splendid protector of shade trees even if it does injure some grapes. A delight to eye and to ear. Its nests are marvels of workmanship. Not surprising that, with Lord Baltimore's colors black and orange, this bird should bear his name or that it should be chosen as State bird of Maryland. Song pitch, 2,050-3,825 c.p.s.

Bullock's Oriole, 508

Icterus bullocki

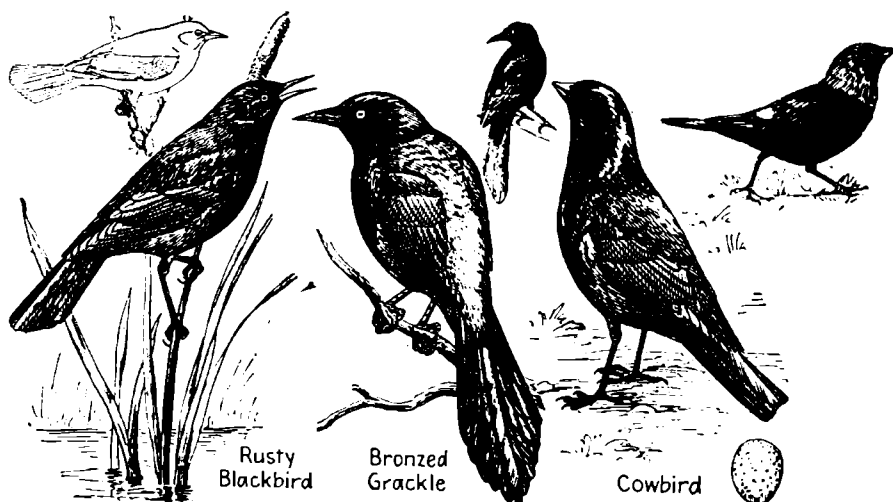
Length to 8½ in., wing to 4 in., tail to 3½ in. Adult male, in summer, rear upper parts and under parts orange or yellow; crown, throat patch, eye line, fore upper parts, and bill black; wings, black with white patch and white edgings. Female with head and neck olive, back and rump olive gray, and throat yellow.

Breeds from southern British Columbia, southern Saskatchewan, and eastern South Dakota south to northern Lower California and southern Texas. Winters in Mexico south to Colima, Guerrero, and Puebla.

Nests in cottonwoods, oaks, mesquites, and box elders or among mistletoe. Nest a hanging bag composed of string, hair, cotton, grasses, and shredded bark, with an inner lining of hair, wool, or down. Eggs 3-6, grayish- or bluish-white marked with irregular hair lines chiefly around larger end.

Food largely insects of orchards, one estimate indicating that 35% of total food is beetles, nearly all of which are harmful species; caterpillars and then, moths 41%, and ants and wasps 15%. Remaining food is largely fruit such as cherries. Young birds are ready to fly by July.

This oriole is almost entirely useful and probably more than pays for fruit it eats by fruit-destroying insects it kills. Its song is one of those which in season dominates other songs within its range and once heard will be again sought.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Icteridae. MEADOW LARKS, BLACKBIRDS

Rusty Blackbird, 509

Euphagus carolinus

Length to 9¾ in., wingspread to 15 in., tail to 4 in. Weight to 2½ oz. A blackbird, about size of a robin. Male with a whitish eye; female slate-colored instead of black and smaller than male. In fall, male a rusty color; female and young with broad light stripe over eye and much browner than male.

Breeds from Alaska to northern Quebec, south to central British Columbia, central Alberta, central Manitoba, central Ontario, New York, northern Vermont, New Brunswick, Newfoundland, and Nova Scotia. Winters south of Ohio and Delaware valleys to Gulf Coast. Accidental in California and Greenland.

Nests in swamp or near waterway borders, in a tree, on a stump, or in brush from 1-10 ft. above ground or water. Nest of sticks and mosses, capped with wet leaf mold which hardens. Eggs 4-5, bluish-green blotched with chocolate or gray, 1½ by ¾ in. Incubation for 14 days, by female. 1 annual brood.

Food, as shown by 132 stomachs of birds collected during migration season, a high percentage of animal food; crustaceans, snails, and little fish constituted about 7% of total. Rarely so numerous as most of related blackbirds and never figure seriously in economic issues.

From evidence available, bird does much good and little if any harm. It lives most of its life in areas not normally considered agriculturally valuable and eats little if any commercially valuable farm products.

Bronzed Grackle, 511b

Quiscalus quiscula

Length to 14 in., wingspread to 19 in., tail to 6½ in. Weight, male to 5 oz.; female to 4 oz. Large blackbird, with long tail with rounded tip. Black reflects bright bronze color in strong light. In subspecies Purple grackle, there are short iridescent cross bars. In Florida grackle, reflection is bottle-green. Temperature, 111.4°F.

3 subspecies include the Purple, the Florida, and the Bronzed grackle, differing as suggested above. Bronzed grackle nests from Great Slave Lake to Newfoundland, south to Colorado east of the Rockies and to Georgia west of the Alleghenies, on to New York, northern Connecticut, and Massachusetts.

Nests commonly in groves of large trees or in parks. Nest sometimes on ground, in a tree cavity, in a building, in a stump, of grass and weeds, reinforced with mud and with fine lining. Eggs 4-7, pale green to light brown, with brown or lavender spots or markings, 1½ by ¾ in. Incubation by female, 14 days. 1 annual brood.

Food listed as 30% animal and 70% vegetal. Animals include worms, crawfish, carrion, mice, birds' eggs, snakes, sow bugs, clams, frogs, and hosts of insects. In autumn, food is more largely plant materials such as grain, nuts, and fruits. Migrate from roost to feeding ground in long files from horizon to horizon. Speed, 30 m.p.h.

Probably more injurious than beneficial, particularly in large numbers in fall months when grain may enter diet prominently. However, good done in vicinity of nesting area should not be overlooked. Purple grackle from Florida Pleistocene.

Cowbird, 495

Molothrus ater

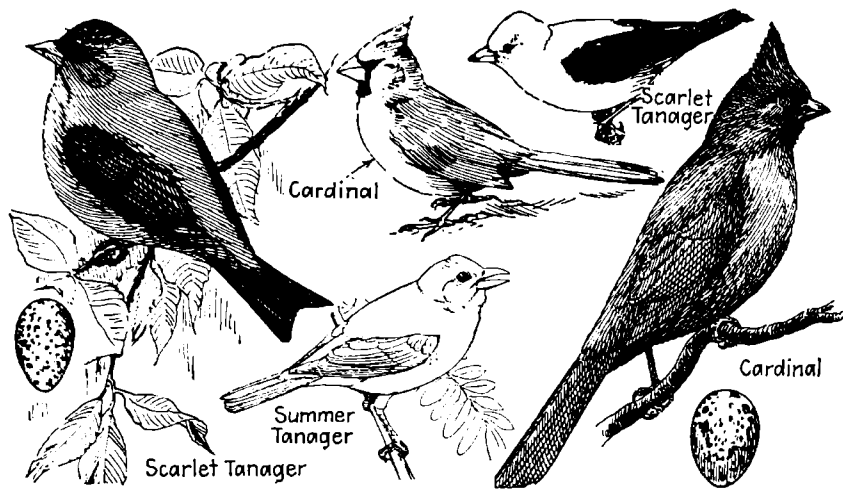
Length to 8¼ in., wingspread to 13¾ in., tail to 3¼ in. Male black with brown head. Female uniformly gray. Smaller than most associated blackbirds. Short stubby bill and short tail make female different from somewhat similarly colored catbird. Weight to 1¾ oz. Female the smaller. Temperature, 101.6-108.4°F.

4 subspecies: Eastern, Nevada, California, and Dwarf cowbirds. Eastern breeds from southern Ontario to Nova Scotia, to Virginia, Tennessee, Louisiana, and Texas, west to eastern Kansas and western Minnesota. Winters south of Ohio and Potomac valleys, on to Gulf Coast and Florida. Subspecies extend range west.

Promiscuous in mating behavior. Female builds no nest and gives no care whatever to her young. Instead, she lays her eggs in nests of other, usually smaller birds, leaving them to be hatched and young to be reared by foster parents. Larger young cowbirds usually crowd out and starve normal offspring of host.

Food, insects and grain. Name cowbird comes from bird's habit of collecting insects from backs and vicinity of cattle. Of 544 stomachs, contents showed 22% animal matter, including grasshoppers, ants, wasps, caterpillars, and particularly army worms. Grain apparently a relatively small percent of year's food.

On basis of food habit, probably cowbird is a useful species. But it probably is universally despised for its habit of letting other birds rear its young to the death of normal young. Its general home life is just about all it should not be according to ethical standards.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes

Family Thraupidae

Scarlet Tanager, 608

Piranga olivacea

Length to $7\frac{1}{2}$ in., wingspread to 12 in., tail to $3\frac{3}{4}$ in. Female smaller than male. Male bright red with black wings and tail in breeding season. Male loses most of red in autumn. Female dull green above and yellowish below. Young like female.

Breeds from southern Saskatchewan to Nova Scotia and south to Arkansas, northern Alabama, northern Georgia, and in mountains of Virginia and South Carolina. Winters from Colombia to Bolivia and Peru, migrating through Cuba, Jamaica, and Yucatan and along east coast of Central America. Tree-top bird.

Nests in high open woods such as oaks or pines. Nest on horizontal limb, to 50 ft. above ground, composed of flat platform of rootlets with interwoven grasses. Eggs 3-5, pale greenish-blue with many brown spots, 1 by $\frac{3}{8}$ in. Incubation 13 days, by female. 1 annual brood. Young with first breeding plumage in 1 year.

Food largely caterpillars and similar slowly moving insects of treetops. Known to eat bark beetles, click beetles, grasshoppers, locusts, wood borers of many sorts and giant native silk moths, such as polyphemus and luna. One recorded eating 35 gypsy moths a minute for 18 minutes.

Useful in every imaginable respect and beautiful to see if not to hear. Its characteristic *chip-churr* is always worth investigating. Its song, like that of a robin with a cold, is somewhat of a disappointment which is speedily forgotten when bird is seen. Song pitch, 2,200-3,625 c.p.s.

Summer Tanager, 610

Piranga rubra

Length to $7\frac{1}{2}$ in. Wingspread to $12\frac{3}{4}$ in. Female smaller than male. Male bright rosy red all over and without black wings and tail of scarlet tanager. Female olive above and yellow beneath and without wing bars of female Baltimore oriole, which it slightly resembles.

Breeds from southeastern Nebraska to central Indiana, central Ohio, Maryland, south to southern Florida and north-eastern Mexico. Winters from central Mexico and Yucatan to Ecuador, Peru, and Guiana. Occasionally north to Maine, Nova Scotia, Quebec, and New Brunswick. Cooper's tanager, a subspecies, extends range to California.

Nests in dry open woodland or in towns. Nest in tree, usually on a horizontal limb 5-30 ft. above ground, of grass and leaves in a shallow cup. Eggs 3-4, $1\frac{3}{8}$ by $\frac{3}{4}$ in.; blue-green, spotted, blotched, or speckled with purple or brown. Incubation 12 days, by female. 1 annual brood.

Lives mostly in treetops where it is not seen easily. Catches insects much like a flycatcher or may glean them from tree's vegetation. Known to eat bees but most have proved to be high-flying drones. Young males may assume adult plumage first winter or may not.

Probably of little economic importance but is interesting to bird lovers. Call a loud, *chic-tucky-tuck* song more musical than that of the scarlet tanager and of different quality.

Family Fringillidae

Cardinal, 593

Richmondia cardinalis

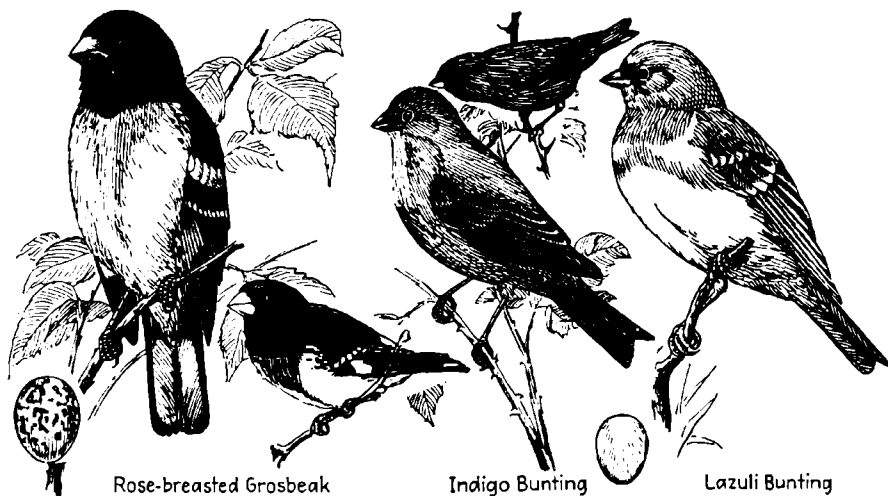
Length to $9\frac{1}{4}$ in., wingspread to 12 in., tail to $4\frac{3}{4}$ in. Weight, male 2 oz.; female, smaller. Male scarlet except for black around bill, with a conspicuous crest. Female yellowish-brown with some red, but with big crest and heavy red bill like that of male.

6 subspecies: Eastern, Florida, Louisiana, Gray-tailed, Arizona, and San Lucas. Eastern is resident from southeastern South Dakota to southern Ontario, and south to Gulf States. Occasionally also in New Brunswick, Massachusetts, Connecticut, Michigan, Colorado, and other states. Subspecies extend range.

Nests in thickets or small trees. Nest of twigs, leaves, and grasses, rather loosely put together, with a lining of finer grasses or hair, 3-30 ft. above ground. Eggs 3-4, variable white, greenish, or bluish, marked with brown or lilac, weight, $8\frac{3}{8}$ g. Incubation for 12 days, by female. 1-3 annual broods.

Food varied: 36% weed and other seeds, 24% wild fruit, 9% grain, 2% miscellaneous plants. Animal matter, 29%, including Colorado potato beetles, cicadas, cotton worms, cutworms, codling moths, leaf hoppers, cotton boll weevils, cucumber beetles, plant lice, and ants. Call, a loud cheery whistle. Song pitch, 2,200-4,375 c.p.s.

Estimated that it does 15 times as much good as it does damage. Formerly sold as cage birds at \$10 per bird but this is now outlawed and bird is protected by law as it should be. Range has extended northward in recent years. Family life of cardinals is worth watching. State bird of Kentucky, Delaware, Illinois, and Indiana.



Rose-breasted Grosbeak

Indigo Bunting

Lazuli Bunting

PHYLUM CHORDATA. CLASS AVES

Order *Passeriformes*. Family *Fringillidae*. BUNTINGS, FINCHES, SPARROWS

Rose-breasted Grosbeak, 595

Phœnicurus ludovicianus

Length to $8\frac{1}{2}$ in., wingspread to 13 in., tail to $3\frac{1}{2}$ in. Female smaller than male. Male black and white, with triangular red breast patch. In flight, appears conspicuously black and white. Female streaked brown, with broad white wing bars and white line over eye. Bills of both sexes conspicuously heavy and light-colored.

Breeds from central Mackenzie to Cape Breton Island, south through central Kansas, southern Missouri, and in mountains to northern Georgia. Winters from southern Mexico and Yucatan to Colombia, Venezuela, and Ecuador. Occasionally in Cuba, Jamaica, Haiti, Bahamas, California, Colorado, and Arizona.

Nests in thickets and woods, usually near water but also on farms and in gardens. Nest 6–20 ft. above ground, near tree trunk or on forked limb, of twigs and grass, loosely assembled, with little lining. Eggs 3–5, blue-green or grayish, with brown or reddish spots, $1\frac{1}{2}$ by $\frac{3}{4}$ in. Incubation 14 days, by both sexes. 1 annual brood.

Food about 52% animal matter, favoring particularly Colorado potato beetle, and giving it name potato-bug bird. Eats buds of forest trees but probably not to dangerous extent. Rarely abundant anywhere. *Chink* call, robin-like song, thick bill, wing bars, and eye line identify it in winter plumage, when it resembles female. Temperature, 100.4–110°F.

Undoubtedly useful and certainly welcome because of its beauty and its call. Seems to be more abundant in Middle West than in East and seems less appreciated there, strange to say.

Indigo Bunting, 598

Passerina cyanea

Length to $5\frac{3}{4}$ in., wingspread to $8\frac{5}{8}$ in., tail to $2\frac{3}{8}$ in. Female smaller than male. Male deep blue all over. In fall, male is more brown but blue shows on wings and tail. Female plain brown, without stripings, wing bars, or other conspicuous markings. Young male may show some blue with brown, but not at first.

Breeds from central eastern North Dakota to southern New Brunswick south to central Texas and northern Florida. Winters from Yucatan through Central America to Panama and in Cuba. Also found in Bahamas, eastern Colorado, southern Saskatchewan, and southern Manitoba.

Nests in bushy country or cutover hardwood lands, usually not over 4 ft. above ground. Nest of twigs and coarse grasses, leaves, hair, and feathers. Eggs 3–4, pale blue, or greenish-white, rarely specked with brown, $\frac{3}{8}$ by $\frac{3}{8}$ in. Incubation by female, 12 days. 2 annual broods.

Food chiefly insects, including cankerworms, brown-tail caterpillars, beetles, including click beetles, and grasshoppers. May eat a few blossoms of fruit trees but does no serious damage. Eats little if any grain. In South in winter, food is largely weed seeds. Song pitch, 3,250–8,875 c.p.s. Speed, 21 m.p.h. Temperature, 107°F.

One of most lovable birds in existence. If we live in country, we hear its incessant call all through early summer and get in habit of searching tops of all neighborhood trees for tell-tale black silhouette of male bird singing.

Lazuli Bunting, 599

Passerina amoena

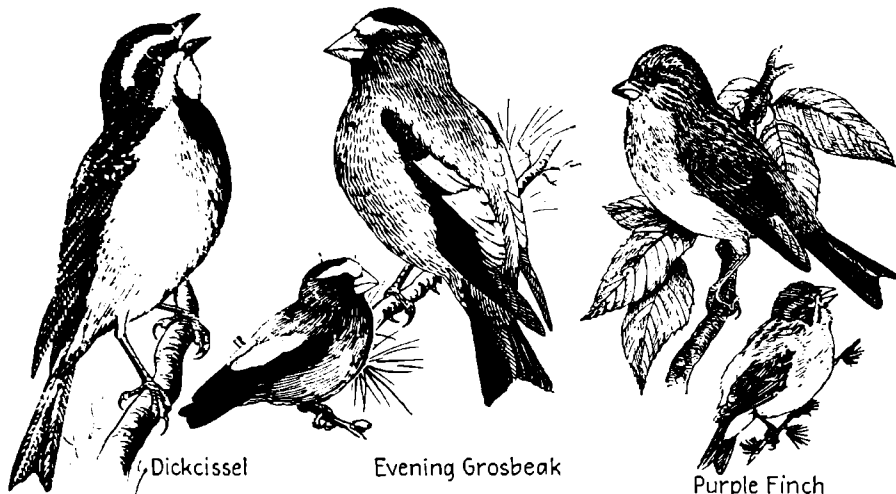
Length to $5\frac{1}{2}$ in., wing to 3 in., tail to $2\frac{3}{8}$ in. Female slightly smaller. Adult male with upper parts turquoise blue, varying to greenish-blue; 2 white wing bars, breast and sides brownish but other under parts white. Female brown, sometimes streaked; rump greenish-blue, chest brownish, and belly white.

Breeds from southern British Columbia to southeastern Saskatchewan and northwestern North Dakota, south to northwestern Lower California and west central Texas. Winters in Mexico south to Valley of Mexico. Accidentally in Minnesota and southern Mackenzie.

Nests usually near water in low bushes, among weeds, in willows, manzanitas, and rosebushes. Nest made of plant fibers including bark, and often lined with hair or other fine materials. Eggs 3–4, plain bluish-white or pale greenish-blue, sometimes spotted.

Food mostly weed seeds and noxious insects, latter including alfalfa weevils and codling moths. In habits, bird reminds one of indigo bunting found to east of lazuli's range. Blue back of male, flashing from top of some weed or from edge of a thicket, tempts one to seek nest.

No wonder that within its range lazuli bunting is popular with those who love birds. Surprising that this popularity has not found expression in its being considered important enough to be a State bird, since it has more beauty than many birds so elected.



Dickcissel

Evening Grosbeak

Purple Finch

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Dickcissel, 604

Spiza americana

Length to 7 in., wingspread to 11 in., tail to 2 $\frac{1}{2}$ in. Female smaller than male. Male like diminutive meadow lark showing usual black bib and yellow breast. Female paler than female English sparrow, with yellowish breast, chestnut on bend of wing, and white stripe over eye.

Breeds from northeastern Wyoming to southeastern Ontario, south to southern Texas and northern Georgia. Formerly bred through to Atlantic plain; now rare east of Alleghenies. Winters from Guatemala to Colombia, Venezuela, and Trinidad, migrating through Central America and Mexico.

Nests in fields and meadows on or near ground, and perches on near-by trees, posts, or wires to sing. Nest on ground among grasses or in low tree or shrub, made of grasses. Eggs 3-5, greenish-blue, $\frac{3}{8}$ by $\frac{3}{8}$ in. Incubation by female, 10-11 days. Probably 2 annual broods.

Food mostly insects, weed seeds, and a little grain. Estimated that one family of dickcissels eats 200 grasshoppers a day and each grasshopper eats 1 $\frac{1}{2}$ times its own weight in plant material. Song *dick-dick-dick-cissel* is repeated again and again by male during nesting season.

This bird signifies the Middle West to many persons. It and red-headed woodpecker populate Iowa's telephone poles clear across state. Estimated that species saves state of Illinois \$4,680 a day during nesting season by insects destroyed.

Evening Grosbeak, 514

Hesperiphona vespertina

Length to 8 $\frac{1}{2}$ in., wingspread 13 $\frac{3}{4}$ in., tail 3 $\frac{1}{2}$ in. Sexes about equal in size, though female may be smaller. Like a large yellowish starling, with a short heavy whitish bill. Undulating flight. Male yellow, with black and white wings. Female gray, with yellow and black obscured.

3 subspecies: Eastern, Western, and Mexican. Eastern breeds from western Alberta to Vermont, south to northern Minnesota, Michigan, and New York. Winters from Saskatchewan to Quebec and south to Missouri and Maryland. Other subspecies extend range to Pacific Coast and to southern Mexico.

Little known of breeding habits. Western subspecies nests in willows; of sticks and rootlets, some 10-12 ft. above ground; Eastern, in spruces 20-50 ft. up. Eggs 3-4, greenish, blotched with pale brown. Eggs in Arizona, June; young on wing in Mexico, late April. Any observations on these birds valuable to bird students.

Food essentially seeds, favoring box elder but eating spruce, pine, cottonwood, locust, birch, wild cherry, maple, ash, tulip, lilac, flowering dogwood, apples, hawthorn, sumac, privet, buckthorn, mountain ash, poison ivy, Virginia creeper, red cedar, juniper, barberry, ragweed, burdock and seeds from horse manure.

Appear erratically in good-sized flocks and stay for a few days only to vanish as quickly as they came; may return daily until mid-May to feeding stations for sunflower seeds. Do little damage, except rarely to tree buds. Too few in numbers to be considered a pest.

Purple Finch, 517

Carpodacus purpureus

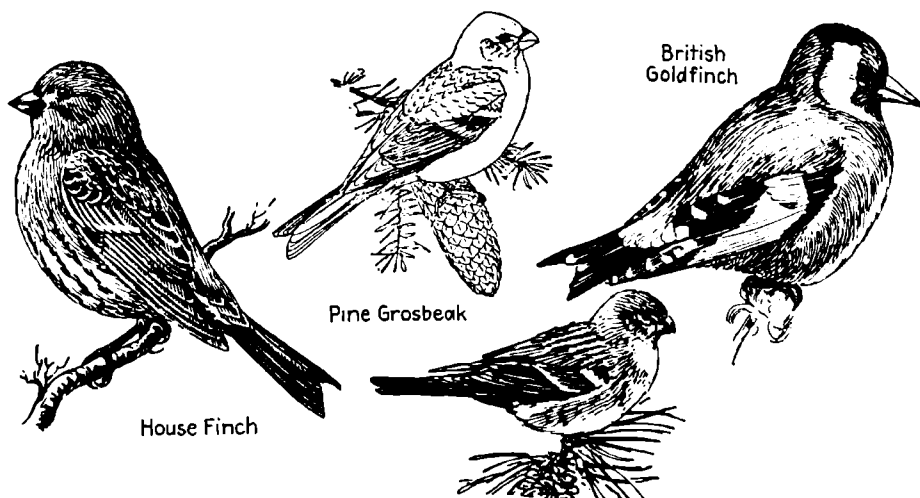
Length to 6 $\frac{1}{2}$ in., wingspread to 10 $\frac{3}{4}$ in., tail to 2 $\frac{1}{2}$ in. Weight to 1 $\frac{1}{2}$ oz. Female smaller than male. Male rosy-red instead of purple as name implies. Color highest on head and rump. Smaller than similarly colored pine grosbeak. Female like heavy-billed striped brown sparrow, with whitish line over eye.

2 subspecies: Eastern and California purple finches. Eastern breeds from northwestern British Columbia to northern Ontario and Newfoundland, south to central Minnesota and Maryland. Winters through United States east of Minnesota and Texas. California subspecies ranges from British Columbia to Lower California.

Lives among hills. Nests in hedges, orchard trees, or more commonly in conifers 5-60 ft. above ground. Nest of vegetable matter usually lined neatly with hair, built by female. Eggs 4-5, greenish-blue with blackish spots near larger end, $1\frac{1}{2}$ by $\frac{7}{10}$ in. Incubation 13 days, chiefly or solely by female. 1 annual brood.

Food in spring essentially insects, buds, and blossoms; in summer, insects and wild fruit, though this may include some raspberries and a few cherries; in fall and winter, wild fruits and weed seeds. Favors fruits of viburnums, dogwoods, and elders. Reports of its bud-destroying habits not well-founded.

Essentially useful as insect and weed-seed destroyer. Male's song a surprise to most people and easily confused with warbling vireo. Most people have to learn it anew each spring but fortunately it is heard before vireos return and renewal of acquaintance is effected simply and enjoyably.



House Finch

Pine Grosbeak

British Goldfinch

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

House Finch, 519

Carpodacus mexicanus

Length to $6\frac{1}{10}$ in., wing to $3\frac{1}{4}$ in., tail to $2\frac{3}{4}$ in. Weight $\frac{3}{4}$ oz. Female about $\frac{1}{2}$ in. shorter, with tail and wing about even in length; streaked gray and brown all over. Adult male with rose-pink throat and rump, line over eye, back not sharply streaked, belly whitish, wings and tail brown-streaked.

3 subspecies: Common, San Lucas, and San Clemente. Common house finch breeds from Oregon and Idaho through northern Wyoming and south through California, New Mexico, Lower California, and Mexico to northern Chihuahua. May extend range east to western Kansas and western Texas.

Nests in bird boxes, sagebrush, salt-bush, mountain mahogany, cactus, tree cavities, buildings, or on tree branches. Nest a shallow cup of grasses, hair, string, and wool. Eggs 3-6; bluish or greenish-white, with spots, dots, and blotches of black or brown near larger end, weight, $\frac{1}{2}$ oz. Temperature, $106-108^{\circ}\text{F}$.

Food 97% vegetal, with less than 1% being grain. Common seeds eaten include Russian thistle, dandelion, sunflower, mistletoe and, unfortunately, some cherries, mulberries, and serviceberries. If serviceberries and mulberries are planted near cherry orchards, they may draw house finches from cherries. Song, an ecstatic warble.

Essentially useful as weed-seed destroyer, but also as a beautiful bird with a splendid song living in a place not always attractively populated. Some persons consider its presence a good index of near-by water; in deserts, this may have a real significance to man's interests.

Pine Grosbeak, 515

Pinicola enucleator

Length to $9\frac{3}{4}$ in. Wingspread to $18\frac{7}{8}$ in. Female usually smaller than male. 2 white wing bars and rosy-red color characterize male. Similar wing bars, with gray general color and rump and head slightly yellow, characterize female. In immature males red is replaced by dull orange.

7 subspecies recognized: Alaska, Kamchatka, Canadian, Kodiak, Queen Charlotte, Rocky Mountain, and California. Canadian breeds from northwest Mackenzie to Labrador and south to Manitoba and northern New Hampshire. Winters south to Kansas, Kentucky, and New Jersey with subspecies extending range as indicated by names.

Nests in evergreen tree, relatively low. Nest of moss and twigs, with hair lining. Eggs 3-4, 1 by $\frac{3}{10}$ in.; greenish-slate to light green spotted and blotched with pale purple-brown, dark purple, or even dark-brown. Nesting May-June. Incubation probably 14 days, mostly or wholly by female. 1 annual brood.

Seen in United States mostly in winter, but this is a dangerous generalization for some subspecies. Most are relatively unsuspicious and are confined chiefly to cone-bearing evergreens where they get their food, mostly from cones. Usually feed in flocks and will clean a tree well of its fruits once they have started.

May do some damage to fruit buds but since they feed chiefly on seeds of evergreens and these are usually superabundant they do little serious damage to anything of economic importance to man. They are ordinarily so unusual that their presence is welcomed, particularly by ornithologists.

British Goldfinch, 526.1

Carduelis carduelis

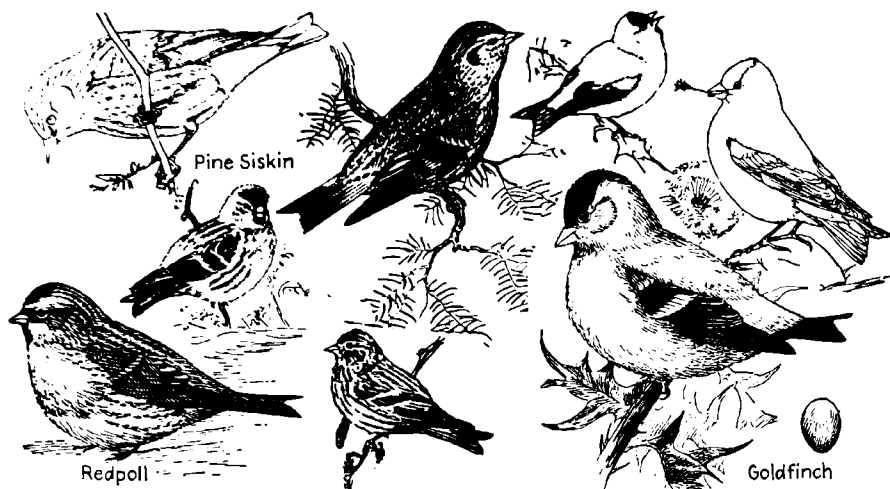
Length to $5\frac{1}{2}$ in., including 3-in. tail and $\frac{1}{2}$ -in. bill. About size and shape of American goldfinch but front part of face is bright red, bordered on crown by black and on side of head by white with black behind to rear of head. Upper parts, breast, and sides brown, darker above. Yellow patch on black wings. Tail black.

Native of British Isles; naturalized in Bermuda and rather poorly in America near New York City. Was first introduced in America in 1878, near Hohenoken, N. J., and for 20 years showed signs of becoming permanently established. Has been seen in central New York State, and there are colonies on Long Island.

Nests usually in orchard trees, but also in others. Nest a well-constructed bowl, used for only 1 brood. Eggs 4-6, pale greenish-white speckled with brownish-red spots and zigzag patches. Incubation 14 days. In captivity, may be crossed with canaries but resultant birds are not fertile and are known as "mules."

Food essentially seeds, with a particular appetite for fruits of thistle as is case with American goldfinch. Kept with canaries, British goldfinches may become able singers. Other related birds used as cage birds in Europe include bullfinch, greenfinch, chaffinch, linnet, hawfinch, and brambling finch.

Interesting to Americans primarily as a cage bird, because it is hardy, beautiful, and a fair singer. It crosses well with some other cage birds and therefore interests those intrigued with breeding unique animals.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Redpoll, 528

Acanthis flammea

Length to $5\frac{1}{2}$ in., wingspread to $8\frac{3}{4}$ in., tail to $2\frac{2}{3}$ in. Female smaller than male. Like small brown sparrows with bright red caps and black chins. General appearance finely streaked or spotted. Male pink-breasted. Flight something like that of goldfinch.

3 subspecies include Common, Holboell's, and Greater redpolls. Common redpoll breeds from Alaska to Gulf of St. Lawrence, south to northern Alberta and northern Quebec; also into northern Europe and Asia. Winters in northern United States, south to northeastern California. Field species.

Nests in thickets of birch, willow, or spruce in far north, usually low or in grass tussock. Nest of available plant material, with lining of down, feathers, or hair. Eggs 4-7, white tinged with green or blue, spotted with reddish-brown; $\frac{3}{8}$ by $\frac{1}{2}$ in. Nesting most common in June. No details on incubation. 1-2 annual broods.

Food largely seeds of weeds and of birches and alders; also seeds of pines, elms, lindens, larch, lilac, and others where they are available. In summer, plant lice play an important part in diet. Friendly, come readily to feeding stations, and are generally useful.

Has bred in captivity freely though it is now against law to keep it captive. Made a good cage bird. Numbers are not sufficient in United States to expect them to be of economic importance but a flock of them in weeds in snow helps make a winter field trip successful.

Pine Siskin, 533

Spinus pinus

Length to $5\frac{1}{4}$ in., wingspread to $9\frac{1}{10}$ in., tail to 2 in. Weight, male $\frac{3}{16}$ oz. Female smaller than male. Appears generally like a brown, heavily streaked, active sparrow with a flash of yellow in wings and on tail. Like goldfinch in winter, it is active in flocks in treetops.

2 subspecies include Northern and Mexican pine siskins. Northern breeds from central Alaska to central Quebec, south through highlands to central California and southern New Mexico, east through highlands from Nova Scotia to North Carolina. Winters over most of United States and northern Mexico.

Nests usually in coniferous forests. Nest usually like a saddle on a limb, 8-30 ft. above ground, rather large, cup-shaped, of twigs and bark with fine lining. Eggs 3-6, pale greenish-blue with brownish spots, $\frac{3}{4}$ by $\frac{1}{2}$ in. Incubation 12-14 days, chiefly by female. 1-2 annual broods.

Food, seeds and fruits of woody plants such as birch, alder, maple, elm, and in winter red cedar, honeysuckle, lilac, and seeds of weeds. One of favorite foods is seeds dug from cones of arbovitae. In summer, food is largely insects, particularly plant lice. Gives a high pitched *tit-a-tit*, as it feeds in flocks in treetops.

Probably harmless and of not much direct economic importance. Nevertheless, birds are welcomed by naturalists at all times because of their busy activities. When one bird of a flock moves in a given direction, all others move in unison.

Goldfinch, 529

Spinus tristis

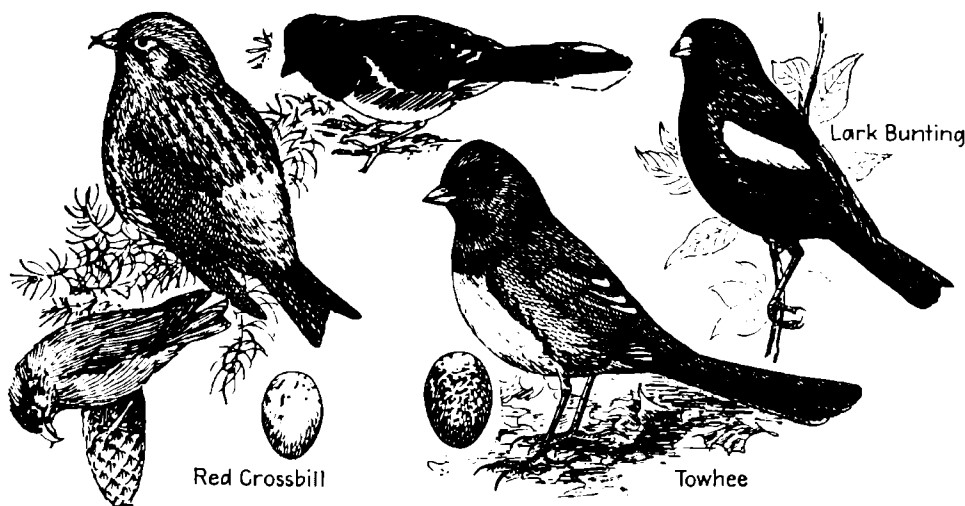
Length to 6 in., wingspread to 9 in., tail to 2 in. Weight to $\frac{1}{2}$ oz. Male in breeding plumage, yellow with black on crown, wings, and tail. Female in summer dull olive instead of yellow, and with the black dulled. In winter, both birds are evenly colored grayish above and below, not streaked.

3 subspecies include Eastern, Pale, and Willow goldfinches. Eastern breeds southern Manitoba to Newfoundland, south to eastern Colorado, central Arkansas, and northern Georgia. Winters through most of breeding area and south to Gulf Coast. Other subspecies extend range to Pacific and into Mexico.

Nests in various kinds of trees and shrubs. Nest rather bulky, cup-shaped, lined with soft downy plant materials like thistle-down. Eggs 4-6, bluish-white, unspotted, weight $2\frac{3}{4}$ g. Nesting and egg laying late in season. Incubation 11-14 days, by female. 1 annual brood. Young birds fed soft seeds, by regurgitation.

Food almost exclusively seeds and dry plant fruits including dandelion, thistle, burdock, chicory, catnip, evening primrose, mullein, sunflower, asters, golden-rods, wild clematis, and many garden flowers as well as fruits of birch, alder, elm, hemlock, spruce, larch, and sycamore. Song pitch, 2,750-7,400 c.p.s. Speed, 18 m.p.h.

Only damage goldfinch might do would be to crop of a commercial grower of garden flower seeds or plant seeds such as lettuce and turnips. With its merry *perchicoree* call and undulating flight in a circle, is welcomed through year by most naturalists. State bird of Iowa, Minnesota, New Jersey, and Washington.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Red Crossbill, 521

Loxia curvirostra

Length to 6 $\frac{3}{4}$ in., wingspread to 10 $\frac{3}{4}$ in., tail to 2 $\frac{1}{4}$ in. Weight $\frac{3}{4}$ oz. Female smaller than male. Male brick red, being brighter on rump and with darker wings and tail. Female and young dull grayish-olive, with plain dark wings. Related white-winged crossbill has 2 white bands on each wing, in each sex.

5 subspecies: the Red, the Newfoundland, the Sitka, the Bendire's, and the Mexican crossbills. Red crossbill breeds from central Alaska to central Quebec, south to Oregon and in highlands occasionally to northern Georgia. Winters farther south, to northern Texas and Florida. Subspecies extend range as indicated generally by their names.

Nests in coniferous forests. Nest usually low, hidden by thick foliage, built of twigs with rootlets and bark mixed in and a lining of moss, hair, or sometimes fur and feathers. Eggs 4-5, pale greenish-blue with brown and lavender spots at larger end. Nest mid-January-July. Incubation 12-14 days, by female. 2 annual broods.

Food essentially seeds of cone-bearing trees, particularly white pine, pitch pine, Norway and native spruces, balsam, larch, hemlock, and also maple, elm, beech, and such weeds as sunflower, dandelion, and evening primrose. May on occasion injure growing fruits such as peaches. Speed, 37 m.p.h.

Has little economic importance, only rarely attacking commercial fruits and then only temporarily. Not common enough to be considered serious agriculturally but it is interesting because of its crossed bills and the way it uses them in extracting seeds from cones. Bird is not at all shy.

Towhee, Chewink, 587

Pipilo erythrophthalmus

Length to 8 $\frac{3}{4}$ in., wingspread to 12 $\frac{1}{4}$ in., tail to 4 $\frac{1}{10}$ in. Female smaller than male, weight, 41 g. Temperature, 108°F. Male with head and upper parts black, sides reddish, and belly white, with abundant white showing near tip of long, loosely hung tail. Female and young like male but brown where he is black. Calls *chewink*.

3 subspecies include Red-eyed, Alabama, and White-eyed towhees. Red-eyed towhee breeds from southeastern Saskatchewan to southern Ontario and Maine and south to central Kansas and northern Georgia. Winters from southeastern Nebraska to Ohio Valley and south to central Texas and Florida.

Nests in brushlands or open woods. Nest on ground or close to it, rarely up 3 ft. Nest of leaves and grasses, with fine lining. Eggs 4-6, white with reddish and sometimes lilac spots, 1 by $\frac{3}{4}$ in.; weight, 7 $\frac{1}{2}$ g. Incubation chiefly by female though male assists, 12-13 days. Annual broods, 1-2.

Food chiefly seeds, wild fruits, and insects, many scratched from under leaves of forest floor. Green-tailed towhee (*Oberholseria*) belongs to a separate genus. 4 species of *Pipilo* include 10 subspecies of *maculatus*, 8 of *fuscus*, and 1 each of *consobrinus* and *aberti*, all being western.

Towhees are undoubtedly useful birds in territory they occupy. Great singers during breeding season and their home life has been studied thoroughly by special students. All who know them agree that they are worth knowing better.

Lark Bunting, 605

Calamospiza melanocorys

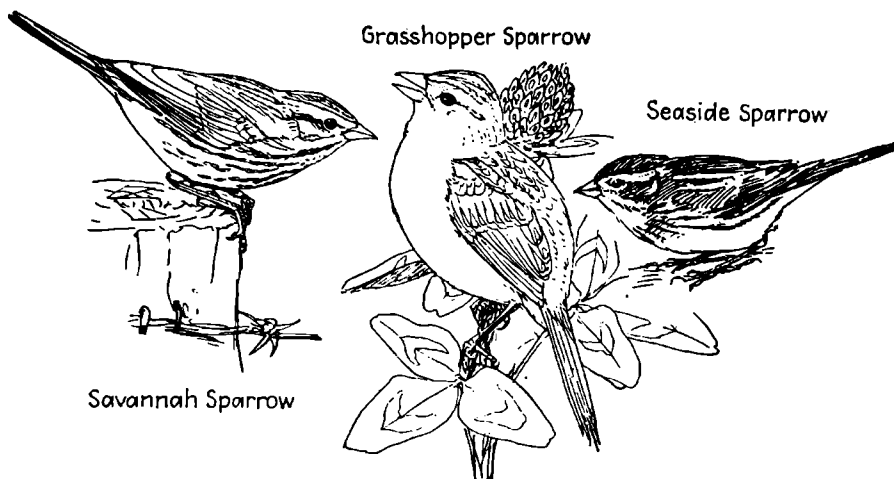
Length to 7 $\frac{1}{2}$ in., wingspread to 11 $\frac{1}{2}$ in., tail to 3 $\frac{1}{4}$ in. Weight 1 oz. Temperature, 101°F. Male like a small sparrow-sized blackbird with large white wing patches. Female, young, and male in autumn brown with breast stripes and conspicuous white wing patches. Not easily confused with other birds because of wing patch.

Breeds from southern Alberta to southwestern Manitoba, south to southeastern New Mexico and northwestern Texas, east to eastern Nebraska and west central Minnesota. Winters south from southern Texas and southern Arizona to Sonora and southern Lower California. Accidental in New York, Massachusetts, and South Carolina.

Nests on ground, in open plains and prairies. Nest often sunk in ground, made of grasses and lined with hair, plant down, or fine grasses. Eggs 4-5, light greenish-blue, rarely sprinkled with reddish-brown spots. Weight $\frac{1}{10}$ oz. Incubation by female. 1-2 annual broods. Male loses black after nesting season.

Food largely seeds of weeds, grass, and grain. Of its animal food, 78% is grasshoppers, though it includes also leaf beetles and weevils. Of the seeds eaten, the important ones are Russian thistle, pigweed, and amaranth, all prominent and pernicious in range of the bunting.

Does some harm to growing grains and may take some toll from harvested and waste crops but this is probably more than offset by the good done in destroying weed seeds and insects. State bird of Colorado.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Savannah Sparrow, 542a *Passerculus sandwichensis*

Length to $6\frac{3}{4}$ in. Wingspread to $9\frac{3}{8}$ in. Weight to $\frac{3}{4}$ oz. Female smaller than male. A distinctly short-tailed sparrow, with a yellow stripe over eye, pink legs, and a slightly forked tail. Tail not rounded or long as in song sparrow, which it superficially resembles. Weight 19 g.

6 subspecies recognized. Breeds from northern Manitoba to northern Quebec and south to Iowa and Long Island, with subspecies extending range to Lower California and British Columbia. Winters from Indiana to New Jersey and south to Mexico and Gulf, subspecies extending range to south and west.

Nests in grassy fields and meadows or along sand dunes and marshes. Nest in a hollow under vegetation, of fine grasses with lining of hair or rootlets. Eggs 4-6, $\frac{3}{8}$ by $\frac{3}{8}$ in.; greenish-white or bluish, spotted and blotched with red- or purple-brown. Incubation mostly by female. 1-2 annual broods.

Distinctly a ground bird, though it may alight in trees for short intervals. Flight undulating and zigzagging, usually ending with a sudden drop into grass. May often be approached closely. Female attempts to lead intruders from nest by faking broken wing. Song a fine *tsit-tsit-tsit-tsee-tsee* not easily heard by everyone.

Food is mostly grass seeds and insects, former constituting about 54% of total. Not known to eat grain and is undoubtedly a very useful species because it lives and feeds in vicinity of agricultural crops and preys on their enemies. Speed, 42 m.p.h.

Grasshopper Sparrow, 546 *Ammodramus saviannarum*

Length to $5\frac{3}{8}$ in. Wingspread to $8\frac{1}{2}$ in. Female smaller than male. A small sparrow with an unstreaked breast, a short tail, and an apparently flattened head. Young birds have streaked breasts. Bill stouter than in savannah sparrow. Sexes colored alike.

3 subspecies recognized: Eastern, Western, and Florida. Breeds from southeastern British Columbia to southern Ontario, south to southern California, southern Texas, northern Georgia and Florida, with other races in Greater Antilles. Winters from southern Illinois and South Carolina to central California to Yucatan, Costa Rica, and Guatemala.

Nests in open fields, pastures, and cultivated fields but not in wet marshes. Nest on ground, sunken or even with surface, grass-covered, of dried grasses with hair or rootlet lining. Eggs 3-6, $\frac{3}{4}$ by $\frac{3}{8}$ in.; glossy white or greenish, sparingly blotched with purple, lilac, or brown. Incubation by both sexes. 1-2 annual broods.

Runs through grass close to ground, keeping well out of sight much of time. Female feigns injury to protect nest. Song, almost inaudible and insect-like, sounds like a faint, oft-repeated buzzing. Young follow adults after leaving nest. May start south in early August.

Food in 170 stomachs showed 73% of kinds of life injurious to man's interests and only 3% of those forms useful to man. It would seem from this that species is essentially useful.

Seaside Sparrow, 550 *Ammospiza maritima*

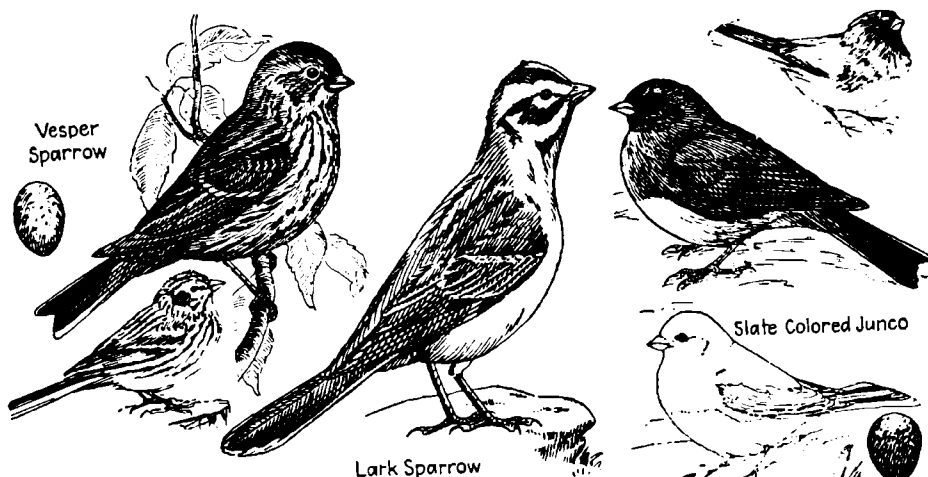
Length to $6\frac{1}{2}$ in., including $2\frac{1}{2}$ -in. tail and $\frac{1}{2}$ -in. bill. Wingspread to $8\frac{1}{2}$ in. Weight, male to $\frac{9}{10}$ oz., female smaller. Tail feathers less pointed than in Nelson's sparrow and sharp-tailed sparrow. Darker, grayer, with less conspicuous light streaks on back than in sharp-tailed, with yellow patch just in front of eye and over it, and white on lower jaw.

Northern seaside sparrow breeds from Massachusetts to Virginia. Winters from Virginia to northern Florida. Other subspecies include Macgillivray's, Scott's (eastern), Wakulla, Howell's, Louisiana, Texas, Dusky, and Cape Sable of the Gulf Coast area. Closely related to Nelson's and sharp-tailed sparrows. All salt-marsh birds.

Nest of northern seaside sparrow is in salt marshes, of grasses with finer lining, over high-water mark. Eggs 4-6, $\frac{3}{8}$ by $1\frac{1}{16}$ in.; grayish-white with reddish-brown spots. Incubation almost wholly by female. 1 annual brood. Adults molt once a year, about August. Young molt after leaving nest and in fall.

Food, small animals of its salt-marsh environment, including particularly many sand fleas and small crabs. Call, a squeaking *cheep* almost like an insect buzzing, but more distinct than call of sharp-tailed sparrow. Sharp-tailed sparrow has buffy yellow on face, distinct dark breast streaks, and is less dingy than seaside sparrow.

Probably of little economic importance other than as a destroyer of small animal pests of seashore marsh plants, which are themselves of little economic importance. The male may engage in a courtship flight, singing as he rises over his home territory.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Vesper Sparrow, 540 *Pooecetes gramineus*

Length to $6\frac{3}{4}$ in., wingspread to $11\frac{1}{4}$ in., tail to $2\frac{3}{4}$ in. Weight 1 oz. White outer tail feathers, which flash as bird flies away, are typical. Also shows chestnut at bend of wings and a streaked breast. It lacks conspicuous breast spot of song sparrow, which it otherwise somewhat resembles.

3 subspecies: Eastern, Oregon, and Western vesper sparrows. Eastern breeds from central Ontario to Cape Breton Island south to western Minnesota, eastern Nebraska, central Missouri, and North Carolina. Winters from southern half of breeding range to southern Florida and mid-Texas.

Nests in open fields and pastures, usually on dry ground, in a slight depression. Nest of grass with finer lining. Eggs 4-5, greenish-white or grayish, with dots, scrawls, or blotches of brown or reddish-purple, $\frac{1}{8}$ by $\frac{5}{8}$ in.; weight $\frac{1}{2}$ oz. Incubation by both sexes, 11-13 days. To 3 annual broods. Speed, 17 m.p.h.

Food 33% animal matter, including cutworms, click beetles, grasshoppers, army worms, weevils, small snails, and earthworms. Plant material includes little grain, and that mostly picked up as waste. Rarely present in good-sized flocks as are many other kinds of sparrows; rather it mixes with other species.

Unquestionably a useful sparrow well entitled to protection. Excellent companion for a walk as it flies on ahead up road, flicking its white-bordered tail and stopping until flight is again necessary. An emotional quality to a vesper sparrow's song. Song pitch, 2,750-6,600 c.p.s.

Lark Sparrow, 552 *Chondestes grammacus*

Length to $6\frac{3}{4}$ in., wingspread to $11\frac{1}{4}$ in., tail to 3 in. Female smaller than male. Temperature, 110°F . Conspicuous in field because of white around sides and corners of rounded tail. Shows chestnut patches on sides of head and white breast with one central dark spot. Young birds have streaked breasts, without central spot.

2 subspecies, Eastern and Western lark sparrows. Eastern breeds from eastern Nebraska through western Minnesota to southern Ontario, to southern Louisiana, West Virginia, and Maryland. Winters in southern Mississippi, southeastern Texas, and eastern Mexico. Western lark sparrow extends range to British Columbia and south to Guatemala.

Nests in open fields and prairie lands. Nest on ground or in low bushes, made of grasses and lined with fine rootlets or long hairs. Eggs 3-5, white, pinkish, or grayish; spotted, streaked, and blotched with brown, black, or purple, weight, $\frac{1}{10}$ oz. Incubation, about 12 days, by female.

Food about half plant and half animal matter, animal matter including particularly grasshoppers and locusts in season, and plant material made largely of weed seeds. Some grain is eaten, as would be expected of such a large sparrow but much of time after breeding season is spent in borders, not in open fields.

An attractive sparrow, holding our attention because of flashing white on relatively long tail. Bird seems something like a towhee that lives in the open. One never forgets the first nest he finds of a lark sparrow.

Junco, 567 *Junco hyemalis*

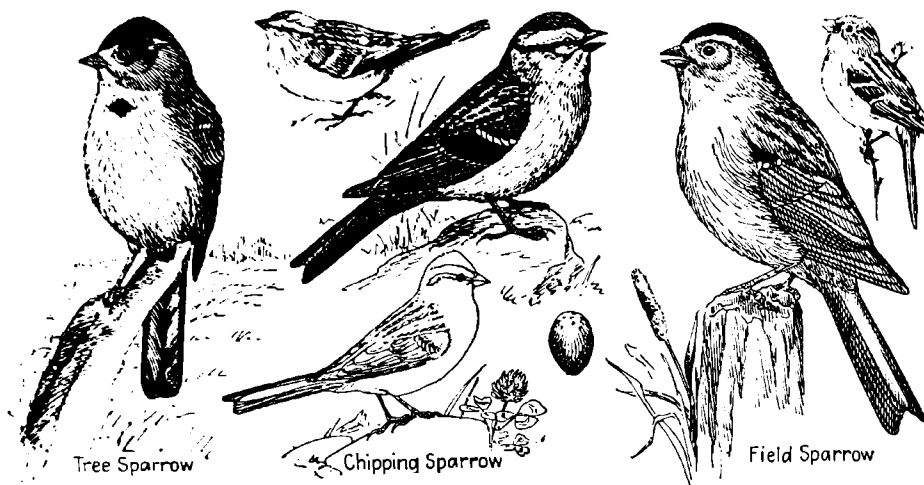
Length to $6\frac{1}{2}$ in., wingspread to 10 in., tail to $2\frac{7}{8}$ in. Weight $\frac{3}{4}$ oz. Female smaller than male. Dark slate-gray above and across throat but light gray beneath. 2 outer pairs of tail feathers white, flashing in flight. Female duller, with second pair of outer tail feathers grayer. Bill bone-colored.

2 subspecies, Slate-colored and Carolina juncos. 7 other American species. Slate-colored breeds from northwestern Alaska to central Quebec, south to southern Alaska, central Michigan, New York, and Pennsylvania. Winters through eastern United States and southern Ontario to Gulf Coast. Known in Siberia. Field or woodland species.

Nests in woods or brushy pasture lands, usually on ground; often hidden under some cover. Nest made of grasses with finer lining. Eggs 4-6, bluish, greenish, or grayish, thickly spotted with fine brown, purple, or lilac marks, $\frac{5}{8}$ by $\frac{3}{8}$ in.; weight $\frac{4}{12}$ g. Incubation for 11-12 days. 1-2 annual broods.

Food in summer largely insects such as grasshoppers, leafhoppers, weevils, click beetles, ants, and leaf beetles; also some wild fruits. In winter, almost entirely weed seeds; estimated 33% winter food ragweed and smartweed, remainder Russian thistle, amaranth, wild sunflower, and other common weeds. Speed, 17 m.p.h. Temperature, 108.4°F .

Undoubtedly a useful species. Popular in winter as a "snowbird" because while blizzards seem to stop activities of most larger outdoor animals they do not hinder activities of junco to any appreciable extent. Twittering spring song in northern migration always welcome. Song pitch, 3,850-5,500 c.p.s.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Tree Sparrow, 559 *Spizella arborea*

Length to 6½ in., wingspread to 9¾ in., tail to 2¾ in. Weight to 1 oz. Female smaller than male. A brownish sparrow with conspicuous round black spot in middle of gray breast, conspicuous red-brown cap, and 2 conspicuous white wing bars. Sexes colored alike. Young with top of head brown, breast streaked.

2 subspecies, Eastern and Western tree sparrows. Eastern breeds from central Mackenzie to Newfoundland, south to southern Ontario, southern Quebec, and Nova Scotia. Winters from southern Minnesota to southern Ontario, south to Oklahoma and rarely to Georgia. Western tree sparrow extends range to British Columbia and California. Field species.

Nests at timber line in thickets, usually near water. Nest on ground or in low bush, made of grasses, rootlets, and weeds with lining of hair or fur. Eggs 4-5, light green or ashy, regularly dotted or marked with light brown, 5/10 by 3/10 in., weight to 4 g. Incubation 11-14 days. 1 annual brood.

Food essentially weed seeds. Beal states that this species consumes 875 tons of weed seeds each winter in Iowa. Within boundaries of United States, probable that 98% of its food is weed seeds, with little or no damage to grain crops.

One of best of winter visitors, which comes readily to winter feeding stations. Its cheerful twittering calls in a weed patch even in a blizzard give one a different idea of winter from that which can be had from an armchair beside a cozy fire. One of our best friends in every way.

Chipping Sparrow, 560 *Spizella passerina*

Length to 5½ in., wingspread to 9 in., tail to 2¾ in. Weight ½ oz. Female smaller than male. A diminutive sparrow, with a black line through eye and a white line over it, a bright reddish cap, a clear grayish breast, and a notched slender tail. Young, faintly streaked below. Temperature, 106.8-107.6°F.

2 subspecies, Eastern and Western chipping sparrows. Eastern breeds from Yukon to Cape Breton Island, south to northern British Columbia, central Texas, southern Mississippi, and central Georgia. Winters in Southern States, north to Oklahoma and New Jersey. Western chipping sparrow extends range to British Columbia and northern Mexico.

Nests usually near where man lives, commonly in ornamental evergreens and windbreaks, 1-25 ft. above ground. Nest a beautiful grass cup with hair lining. Eggs 3-5, greenish-blue dotted, spotted, or lined with black or lilac, 3/8 by 5/16 in. Incubation 10-12 days, by both sexes. 1-2 annual broods. Speed, 20 m.p.h.

Food mostly small insects and grass seeds. It includes grasshoppers, weevils, plant lice, gypsy moths, cabbage worms, beetworms, cankerworms, army worms, and seeds of ragweed, purslane, and plantain as well as grass. In numbers, may do damage to newly seeded plots by eating seeds, but this is unusual. Song pitch, (Eastern) 3,475-8,400 c.p.s., (Western) 3,300-5,500 c.p.s.

A chipping sparrow gleaning insects from a spray of apple blossoms outside window is bound to make one smile as he rises in the morning. Its faint chipping call and its loud chipping song are as much a part of eastern orchards and country lawns in summer as grass itself.

Field Sparrow, 563 *Spizella pusilla*

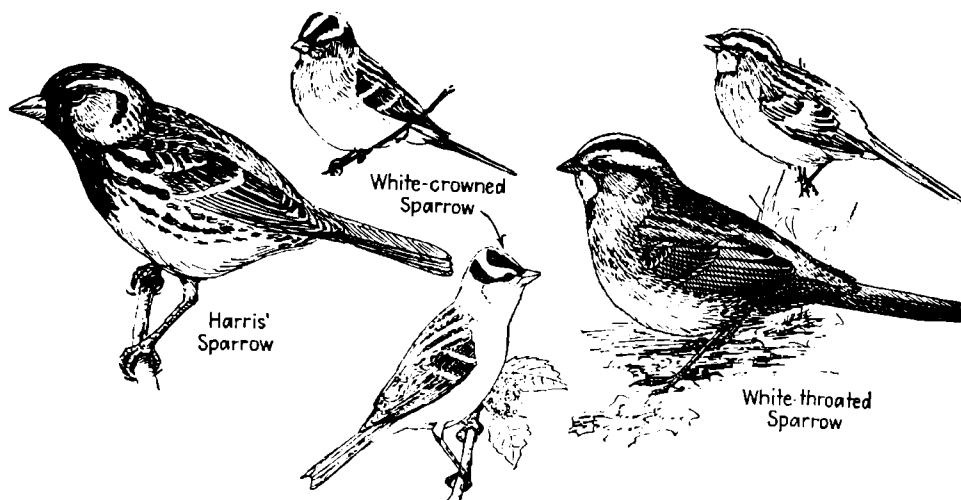
Length to 6 in., wingspread to 8½ in., tail to 2¾ in. Female smaller than male. Sexes colored alike, with reddish upper parts, a clear unmarked breast, a rather inconspicuous eye ring, and a pinkish or flesh-colored bill, the last being the distinctive character. Young, finely streaked.

2 subspecies, Eastern and Western field sparrows. Eastern breeds from southern Minnesota to southern Quebec and Maine, south to central Texas and northern Florida. Winters from Missouri to New Jersey south to Gulf Coast. Western field sparrow extends range to Montana and southern Texas and Nuevo Leon.

Nests in open fields, berry patches, and woodland borders. Nests in low bush, on ground or up to 10 ft. above ground, of grasses, often with a scant hair lining. Eggs 4-5, grayish- or bluish-white, spotted and dotted with light brown or lilac, 3/8 by 5/16 in. Incubation 13 days, chiefly by female. 1-3 annual broods.

Food, animal matter, about 41% consisting of May beetles, leaf beetles, grasshoppers, bugs, sawflies, ants, flies, click beetles, crickets, plant lice, tent caterpillars, and cankerworms. Plant food largely fruits of grasses, including small amount of grain. Song a series of clear, whistled notes, louder and more musical than those of chipping sparrow. Pitch, 3,650-5,100 c.p.s.

A useful bird justly protected by law. Probably destroys fewer insects than associated chipping sparrow but is useful in this direction. To most persons "just sparrow" until it takes to singing and then a sure sign of spring and early summer.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Harris's Sparrow, 553

Zonotrichia querula

Length to $7\frac{3}{4}$ in., including $3\frac{3}{4}$ -in. tail and $\frac{1}{2}$ -in. tail. Wingspread to over 11 in. Female slightly smaller than male. Sexes colored alike. Upper parts brown, with back and shoulders black-streaked, and wings with 2 white bars. Most conspicuous is black crown, forehead, throat, and upper breast contrasted by white on cheek and breast.

Breeds from Fort Churchill, Hudson Bay, to Artillery Lake, Mackenzie, just south of the Barren Grounds. Winters from northern Kansas to western Missouri and southern Texas. Migrates east to western Ontario, occasionally Massachusetts and west through Montana, Wyoming, and eastern Colorado but in great numbers through Iowa region.

Nests near timber line, among small spruces. Nest on ground, of dried grasses. Details of nesting habit not thoroughly known. Young birds look much like song sparrows and in first winter have white throats with a necklace of black spots rather than broad black bib of adult.

Food: 100 stomachs showed 92% of food of vegetable nature, including about 10% grains and 42% seeds of ragweed and smartweed, with balance of seeds of other plants. The 8% of animal matter included 2% leaf hoppers, also spiders and snails. Call a beautiful but not strong, plaintive song, suggestive of that of white-crowned sparrow.

Decidedly useful as a destroyer of weed seeds and worthy of every protection. During years the author lived in the Middle West this was one of the birds he always watched for in the spring and missed when it had passed on farther north.

White-crowned Sparrow, 554

Zonotrichia leucophrys

Length to $7\frac{1}{2}$ in. Wingspread to $10\frac{1}{4}$ in. Female smaller than male. Large sparrow with clear gray breast, high crown that is conspicuously black-and-white-striped from fore to aft, and lacking conspicuous white throat of otherwise rather similar but browner white-throated sparrow. Head stripes in young brown rather than black. Bill pink.

Subspecies breeds from British Columbia to central California in mountains, east to central Greenland and northern Quebec. Winters from southern Lower California to Ohio and Potomac river valleys, south to Florida and central Mexico. Conspicuous during migration period to those who are field naturalists.

Nests in brushlands or open woods, usually in hilly country. Nest on ground or a foot or so above it, in dense vegetation, of grass, roots, and leaves with finer lining. Eggs 4-5, $1\frac{1}{2}$ by $3\frac{3}{4}$ in.; bluish- or grayish-white, spotted and dotted with brown or red-brown. Nests June-July. Incubation 12-14 days, by female. 1 annual brood.

Often seen in flocks in migration areas and first experience with birds is always remembered, particularly if it is a rainy morning and birds are giving their whispering song. Food largely insects during spring and summer; seeds during remainder of year.

Probably neutral in economic importance but certainly high in emotional importance. While in essentially agricultural parts of its range its food is mostly weed seeds, so it must be considered as entitled to protection it receives from law.

White-throated Sparrow, 558

Zonotrichia albicollis

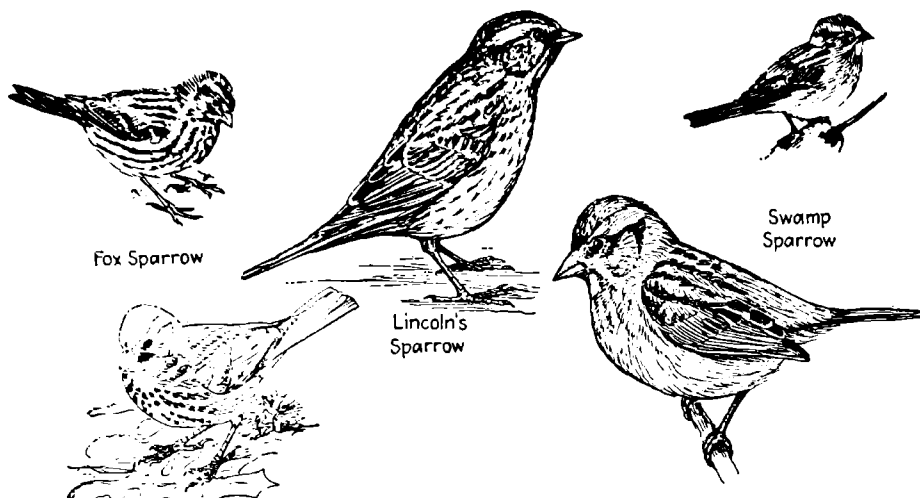
Length to $7\frac{1}{2}$ in., wingspread to 10 in., tail to $3\frac{1}{4}$ in. Weight to $1\frac{1}{4}$ oz. Large sparrow with black-and-white-striped crown, with yellow on line between eye and bill and remarkably clean-cut white throat patch. Female duller and smaller than male. Related white-crowned sparrow lacks white throat and is grayer.

Breeds from northern Mackenzie to Newfoundland, south to southern Montana, central Minnesota, and highlands of New York and Pennsylvania. Winters from Missouri and southern Pennsylvania to Florida and northeast Mexico. Occasionally in Oregon, California, Utah, Colorado, and Lower California.

Nests in brushy pastures, thickets, and wet spots. Nest usually on ground or under brush, or rarely to 2 ft. above ground, of grasses and leaves with finer lining. Eggs 4-5, bluish, grayish, or greenish with dots or spots of dark brown or black, weight, 5 g. Incubation 12-14 days, by female. Usually 2 annual broods.

Food mostly seeds and animal life gathered from surface of ground or scratched from just below surface. It takes little grain and that is mostly waste. Eats seeds of poison ivy, smilax, and red alder among other vegetable materials. Bird hops, digs with bill, and scratches for food.

This is the bird whose plaintive "Ol' Sam Peaboddee" song intrigues hosts of spring naturalists. To many, this song makes the migration season one truly worth while. A "whitethroat singin' in the rain" is worth getting up in the morning to see and to hear.



Fox Sparrow

Lincoln's Sparrow

Swamp Sparrow

PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Fox Sparrow, 585

Passerella iliaca

Length to $7\frac{1}{2}$ in. Wingspread to $11\frac{3}{4}$ in. Weight to $1\frac{1}{2}$ oz. Female smaller than male. Large brown sparrow with bright-red tail and with gray on neck. In flight, tail is most conspicuous. Breast streaked with brown rather than spotted as in hermit thrush, which it otherwise resembles rather closely.

16 subspecies recognized, covering North America rather completely. Eastern fox sparrow breeds from northwest Alaska to Newfoundland south to northern Manitoba and northern Quebec. Winters from Ohio and Potomac Valley to central Texas and Florida with other subspecies going on to Lower California.

Nests in alder thickets and evergreen woodlands, on ground or a few feet up on a sheltered branch. Nest large, of dried grass, moss, and leaves with lining of feathers and hair. Eggs 4-5, $1\frac{3}{8}$ by $\frac{7}{10}$ in.; bluish-white to gray, thickly spotted with reddish-brown, weight $6\frac{1}{2}$ g. Nests in June-July. Incubation 12-14 days, mostly by female.

Industrious sparrow that scratches earth with both feet at once; avoids areas settled by man. It sings little while it is in United States but in its breeding ground gives delightful tingling bell-like song that may be prolonged.

Food is probably about half seeds and half insects and it could not by any stretch of imagination be considered a harmful species. It is always watched for by ornithologists in early spring migrations in East and Middle West.

Lincoln's Sparrow, 583

Melospiza lincolni

Length to 6 in., including 3-in. tail and $\frac{3}{8}$ -in. bill. Wingspread to $8\frac{3}{4}$ in. Female smaller than male. Like a short-tailed small song sparrow, with streaks on underside finer and not clustered to form a spot as in song sparrow. Has a broad light brown band across breast, most conspicuous in upper part. Young much like adults.

Breeds from Kowak and Yukon valleys in Alaska, through southern Mackenzie, Manitoba, and Quebec, to Newfoundland and south to New Brunswick, northern New York, and in West along Rocky Mountains to southern California and northern New Mexico. Winters from central California to northern Mississippi, south to Lower California, southern Mexico, and central Guatemala.

Nests in a tuft of grass, usually near water, on ground. Nest made of grasses with a finer grass lining. Eggs 4-5, smaller than those of song sparrow, $\frac{4}{5}$ by $\frac{3}{8}$ in.; white, greenish-white, or pale green sometimes speckled with brown. Nesting season June. Nesting birds are not commonly seen.

Food probably largely seeds of weeds commonly eaten by most sparrows of its environment. Call a sharp *chip*, like that of song sparrow. Song wren-like, a repeated *quee* ended with *eedle* or *seedle*, but not so loud and vigorous as that of song sparrow.

Probably a useful sparrow but never sufficiently abundant to be of much importance. Because of close resemblance to song sparrows, they may be more abundant than we suppose as they are easily confused with them.

Swamp Sparrow, 584

Melospiza georgiana

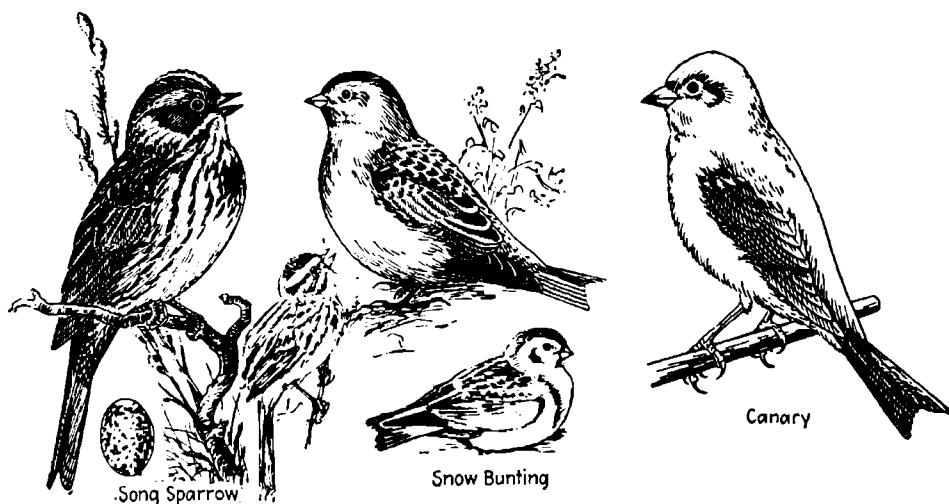
Length to $5\frac{9}{10}$ in., including $2\frac{3}{8}$ -in. tail and $\frac{1}{2}$ -in. bill. Wingspread to 8 in. Female smaller than male. Somewhat like a reddish song sparrow but stouter, with light throat, reddish cap, and clean gray breast. More nearly size of a husky chipping sparrow. Young brownish, with fine breast streaks much like those of song sparrow.

Breeds from west central Alberta to Newfoundland and south to northern Nebraska, Pennsylvania, and New Jersey. Winters from Nebraska, and rarely in New York, to Gulf Coast from Florida to Tamaulipas and Jalisco, Mex. Sometimes found in Utah, Colorado, California, and Bermuda. Bird is commonly found in brushlands and cattail marshes.

Nest in dead sedge tangles or among grasses, composed chiefly of grass. Eggs 4-5, $\frac{5}{8}$ by $\frac{3}{8}$ in.; like those of song sparrow but slightly smaller and with less distinct markings. Incubation 12-15 days, probably by female only. 1-2 annual broods. Young with yellow mouth lining rather than pink or gray of song sparrow.

Food largely insects and weed seeds, insects being chiefly aquatic because of habitat of bird. Song somewhat like a loud, more musical chipping sparrow's greeting, usually on one monotonous tone but sometimes with a sweet trill. At a distance, it might be confused with that of chipping sparrow, but probably even then its quality would distinguish it.

Probably of no great economic importance because it does not feed near areas commonly under cultivation by man. Young birds are inclined to sit close and will remain in nest until 13 days old if not unduly disturbed. Adult plumage usually assumed by the first fall molt.



PHYLUM CHORDATA. CLASS AVES

Order Passeriformes. Family Fringillidae. BUNTINGS, FINCHES, SPARROWS

Song Sparrow, 581

Melospiza melodia

Length 6½ in., wingspread 9½ in., tail 3 in. Weight ½ oz. Female smaller than male. A brown sparrow with a large central black spot on streaked breast, a rounded tail which it pumps up and down vigorously, and a habit of singing from a conspicuous perch in defense of its home territory. Temperature, 101.8–102.6°F.

26 subspecies, including Eastern, Mississippi, Mountain, Dakota, Aleutian, Desert, and San Diego. Eastern breeds from Mackenzie to Cape Breton Island and south to Missouri, Texas, and Florida. Garden and brushy land species.

Nests on grassy land, in brush or ornamental shrubbery, preferably near water. Nest of grasses and weeds with a finer lining. Eggs 3–7, variable, greenish, grayish, pinkish, or bluish with spots or blotches of brown or lilac, 1½ in. by ¾ in.; weight, 4½ g. Incubation 10–14 days, by female chiefly. 2–4 annual broods.

Food 66% vegetable material, largely seeds. Animal matter includes cutworms, army worms, cabbage worms, locusts, grasshoppers, cankerworms, and others. Little if any grain in diet. Some birds can survive severe winter weather. Speed, 17 m.p.h.

Song has been well interpreted as saying "Hip, hip, hooray, boys! Spring is here." Even if it did not, we might well say it when the bird starts to sing because it is the sign that pussy willows, tulips, and dandelions will soon be the order of the day. Song pitch, 1,900–7,700 c.p.s.

Snow Bunting, 534

Plectrophenax nivalis

Length to 7¾ in., wingspread to 13 in., tail to 3½ in. Female smaller than male. Color largely white, showing particularly when in flight. In breeding, male mostly white with black back but when seen in winter in United States, head and upper parts are veiled in brown that disappears in spring. However, no other bird of its size has so much white.

2 subspecies include Eastern and Pribilof snow buntings. Eastern breeds from northernmost mainland of Alaska to Greenland, south to northern Quebec; also in Scotland and Scandinavia. Winters south from Unalaska and central Quebec to northern United States; in Europe, to the Mediterranean. Open field species.

Nests on barren grounds among rocks or grasses, usually hidden. Nest largely of grasses, plant stems, and mosses with lining of fur, feathers, or hair. Eggs 4–8, white, greenish, or bluish with spots or blotches of brown, yellow-brown, or blackish-brown, 1½ in. by ¾ in.; weight to 6 g. Incubation 14 days, chiefly by female. 1 annual brood.

Food, weed seeds as well as seeds of a number of lower woody plants such as alders. On breeding ground during summer months many insects are eaten. Bills exceptionally sharp and strong and can break seeds readily. Associated with snow by most people. Speed, 16 m.p.h.

Formerly were shot for market and are still killed and eaten by natives of North. One city was once reported to have had 80,000 snow buntings in cold storage. Fortunately, such slaughter has been stopped but birds do not seem to have regained their former abundance. They are, alive, essentially and perennially useful.

Canary

Serinus canarius

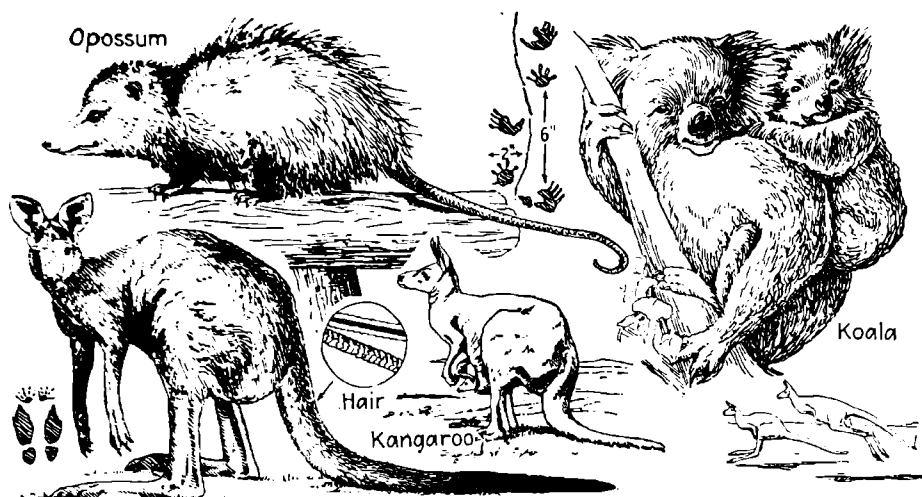
Length to about 6 in., tail to about 2½ in. Color and size vary greatly with breeds. English canary breeds are larger, brighter colored, and louder singers. German canary breeds usually have more varied songs, sing more readily, and are raised primarily for their song not for their appearance.

Native of Canary Islands; wild birds are also found in Madeiras and Azores. Harz canaries are bred in Harz Mountains. The "roller" type is designated as the opera singer and the "chopper" type as the jazz singer. Varieties include Norwich, Scotch, Belgian, German, and Yorkshire.

Captive birds nest in cages. First egg laid about eighth day after mating, then an egg a day until 4–5 are laid. Fed fresh egg paste to induce egg laying. Incubation 13 days, by both sexes, mostly by female. Young fed by both parents for 3 weeks in nest, but by 6 weeks can eat soaked seeds by themselves. Life span occasionally to 24 years.

Food, seeds, particularly German summer rape, Sicilian canary seed, and some hemp seeds with occasionally some apple, cuttlebone, and sometimes with breeding birds, some yeast. Males breeding should not be over 4 years old preferably should be 1–2. Female may be slightly older. A pair should have 16- by 18-in. cage.

Canaries make great pets and, with care, may be trained to come to calls and to perform tricks before eating. Young birds may begin to warble by 8 weeks of age when singing males may be separated from quiet females. Young begin to molt at 6 weeks and shed large wing and tail feathers when 1 year old. Hearing range, 1,100–10,000 c.p.s.



PHYLUM CHORDATA. CLASS MAMMALIA*

Order Marsupialia Family Macropodidae

Family Didelphiidae

Opossum

Didelphis virginiana

Length to 36 in., with 15-in. rat-like prehensile tail. Weight to 5 lb. Male much smaller. Female has brood pouch. Ears naked, black and white. Feet black. General appearance furry, grayish-white. Eyes large, dark, and conspicuous in white face. Toes 5 on each foot, widespread; make star-like tracks; hind toe opposable. Teeth:

1 $\frac{5}{4}$, C 1, P $\frac{3}{3}$, M $\frac{4}{4}$

Common in wooded areas where dens may be established in hollow trees and food is convenient. Only North American marsupial. Found from New York west to Iowa, south through central Mexico, along coast to middle Florida and southern New England. Introduced and well-established in southern California.

To 20 young born 1 $\frac{1}{2}$ –13 days after mating; each smaller than honeybee, $\frac{1}{2}$ in. long with $\frac{1}{8}$ -in. tail; weight $\frac{1}{2}$ to 1 oz., makes way to brood sac and attaches self to 1 of 13 teats. Those unsuccessful die. Increases 10-fold in 1 week; nurses 2 months; at 4 weeks sucks head from pouch; at 8 weeks may leave pouch temporarily; at 8 weeks shifts for self. Breeds at 1 year. 1–2 litters yearly. Life span 8 years.

Food almost anything organic; eggs and persimmons, favorite food. Climbs trees readily with help of tail and feet. May threaten fight if cornered but more likely to pretend death. May sleep in filthy den in bad weather in burrow or hollow log. Usually active throughout year but mostly at night. Relatively harmless to man. Tracks: F 1 $\frac{1}{4}$ x 1 $\frac{1}{2}$, 5; H 1 $\frac{1}{4}$ x 2 $\frac{1}{2}$, 5; Sp 6.

Enjoyed as food by some persons. Undoubtedly a pest to poultrymen but provides sport for hunters and destroys mice and many insects. Ranks among the first 6 species in importance as fur bearer despite fact that fur is cheap and not durable. Number on increase in northern areas. Enough fat to fire 3 37-mm. shells.

Great Gray Kangaroo

Macropus giganteus

Largest kangaroo. Male 5 ft. from nose tip to tail base; tail 3 ft. long. Weight to 200 lb. Female about $\frac{2}{3}$ size of male, with conspicuous brood pouch. Fur soft, gray-brown above and white below, with that on toes and tip of tail black. Some kangaroo species, called "wallabies," are no larger than rats.

This species found in open fields, commonly near water, through large part of Australia and much of Tasmania. Other species in mountainous districts; some even live in trees. Also related to kangaroos are koala (Teddy bear), wombat, and a South American shrew.

One 1-oz. young born 1 month after mating of male boomer and female flyer, makes way in $\frac{1}{2}$ hour to brood pouch where it attaches to teat; develops several months. Young joey rides in mother's pouch until well developed, frolics with others during hot part of day while mothers rest. Except at mating time, adults are peaceful to all. Life span 15 years.

Food purely vegetable matter, browsed from ground as by cattle or taken to mouth with forefeet. When excited, straightens up, leaps 9–10 yd. at a bound, to 10 ft. high, using tail as balance but not as springboard. Commonly found in herds of 30–50. Cornered, may kill large dog with blow from hind feet or hold it under water until drowned.

Hunted for leather which is waterproof, for flesh, and for sport. Leather makes excellent shoes. Hunting so uncontrolled that larger species are almost exterminated. 500,000 killed, 1877–1902. Natural foes, dingoes, took to killing sheep. Dogs bred from mastiff and greyhound are used in hunting kangaroos. Seen in circuses.

Koala, Australian Bear

Phascolarctos cinereus

Length about 24 in. Height about 12 in. at shoulder. Ears large and hairy. Fur thick, ash-gray above and more yellowish below. Head thick, with short snout. Mouth with cheek pouches. Both front and hind feet are "hand-feet," with thumb opposable; in forefeet, first finger is also opposable. Second and third toes in hind feet are united.

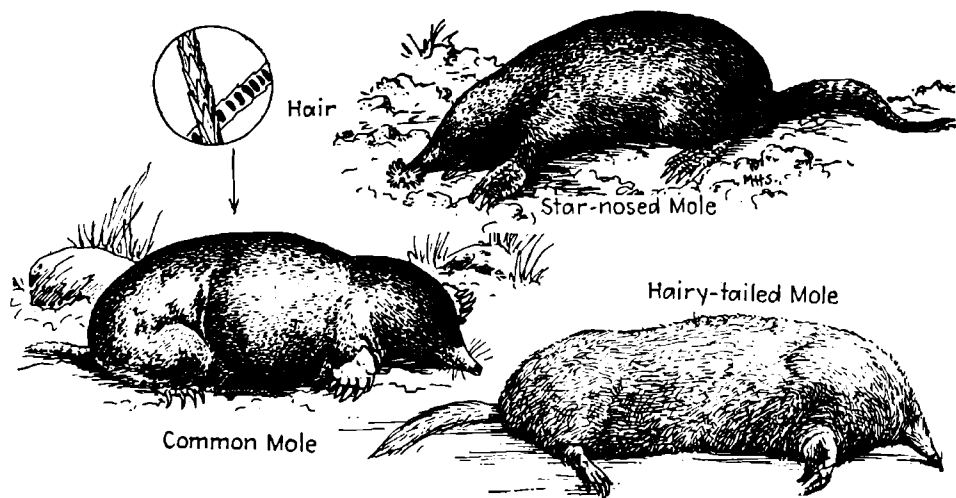
Native of Australia and Tasmania, where it lives for most part in treetops. Close relatives include the wombats that look bear-like, with short thick legs; the flying phalangers that glide and look something like flying squirrels; and the marsupial shrews.

Families remain together, and a pair with a single young are commonly found together with the young either in the mother's pouch or clinging to her back. Young animal remains in mother's pouch about 3 months, then rides about on her back for several more months.

Lives mostly in the gum or eucalyptus trees, on whose leaves it feeds. During the day, sleeps in lower branches but at dusk becomes active, leaping about the tree and even jumping as much as 5 ft. at a single leap, landing safely on smooth tree bark.

Flesh considered excellent by natives and fur has high market value; too high in fact for good of animal, since it has been almost eliminated from much of its natural range. Many are kept captive in parks and prove popular as living "Teddy bears." When wounded, cries piteously, much as a human being would.

* For introductory material to the mammals, see p. 474.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Insectivora. Family Talpidae. MOLES

Common Mole
Scalopus aquaticus

Length, male $7\frac{1}{2}$ in., tail $1\frac{1}{2}$ in., female $6\frac{1}{2}$ in., tail $\frac{3}{4}$ in. Close, thick, velvety, gray, soft fur that is smooth if brushed either way. Tail naked or practically so. Forefeet modified into spade-like structures. Nose like a pick. Eyes small and apparently missing. Feet and tail whitish. Muzzle naked. Teeth: I $\frac{3}{2}$, C $\frac{1}{0}$, P $\frac{3}{3}$, M $\frac{3}{3}$.

Found in burrows, just beneath surface of soft loose ground. Eastern forms, found from southern Massachusetts, across southern tip of New York, to Nebraska, south to the Gulf. Western moles of genus *Scapanus*, found from Washington to southern California in western portions. Hairy-tailed moles, *Parascalops*, northeastern.

At breeding time, 2-3 moles to a tunnel indicate males tolerate each other. Breeds in March. 4-5 young born in 6 weeks, mid-April. Litter independent by mid-May. Mature at 10 months. Males may come to surface at breeding time to seek mates. Nest 5-8 in., grass-lined den. Fur durability, 7% that of otter.

Food choices: first, white grubs and earthworms; second, insect larvae; third, adult insects; fourth, plant materials, the last constituting about 13% of total volume. Food detected by contact and crushed against burrows. Will eat corn, wheat, and oats but not beans or peas. Daily food totals $\frac{1}{2}$ weight of animal. No hibernation. No food storage.

May injure lawns and some gardens but since over 50% of food is insects, undoubtedly serves a useful function. Earthworms, constituting 31% of food, might be considered useful soil tillers as are the moles. Controlled by pests including a beetle, *Leptinus*; a louse, a flea, and threadworms.

Star-nosed Mole
Condylura cristata

Male: length to 8 in., tail $3\frac{1}{2}$ in. Sexes colored alike, blackish-brown above and paler beneath. Males average 53 g., heaviest 70 g. Females average 50 g., heaviest 77 g. Nose terminates in disc of 22 fleshy rose-colored processes. Legs short and weak. Forefeet modified for digging. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{4}{4}$.

Found in damp meadows and marshes from southeastern Canada and southern Labrador to southeastern Manitoba, northeastern Illinois, Ohio, and south along Appalachian highlands to Dismal Swamp in Virginia, western North Carolina, and Georgia. Often lives in same region and same tunnels used by eastern mole.

Tail enlarges in winter. May pair in autumn (?), remaining together during breeding season. Male sexually mature by January. Usually 3-6 young born April 15-June 15; when furred, weigh about 25 g.; independent at 3 weeks; mature at 10 months; 1 litter, born in spherical nest of grass and leaves, about 8 in. through, under some cover.

Diurnal or nocturnal. Often gregarious. Bulk of 107 stomachs shows 49% worms, 33% insects, 8% miscellaneous, 6% crustaceans, 2% mollusks; 2% vertebrates. Detects food probably by contact through snout. Digs way through loose moist earth with modified forefeet. Hearing keen; sense of smell poor.

Probably of neutral value; injurious because they dig burrows used by more destructive mice. May be of some use as tiller of soil. Fur of value. Interesting to all biologists. May be controlled by using traps of deadfall type.

Hairy-tailed Mole
Parascalops breweri

Length, total 6 in. in either sex. Females with hind foot $\frac{3}{4}$ in., males with hind foot $\frac{1}{2}$ in. Color of sexes similar. Like eastern mole in general appearance, but with a hairy tail that is small in diameter at the base and with a shorter snout. Fur soft but coarser than in most other moles with which it might be confused. Teeth: I $\frac{3}{3}$,

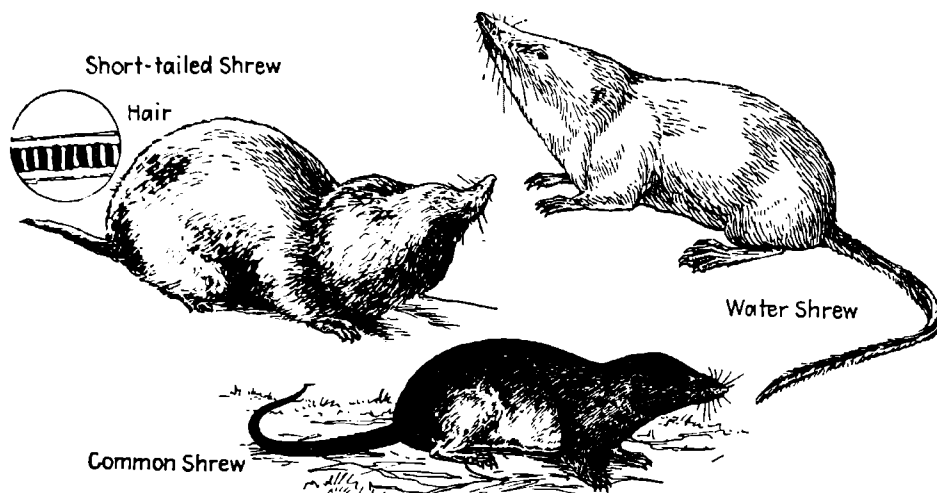
C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{3}{3}$.

Found from southern New Brunswick to eastern Quebec, south to northeastern Ohio and southern Pennsylvania, and in the mountains still farther south to North Carolina. Rarely common and varies greatly in abundance through its range. Probably occurs in many places where it has never been noticed.

Its life habits are probably much like those of the common mole but little is known about it. Mates in late March or early April. 4-5 young born 1 month later; blind and helpless at birth but independent in 4 weeks and sexually mature by next spring.

Its food is mostly insects to be found underground, earthworms, and other small forms of animal life caught by burrowing through ground. Undoubtedly, open burrows are used by mice that may destroy plants not sought by mole. Eats more than its own weight in a day.

Of little economic importance, largely because of its scarcity. More abundant, it might serve to control the multiplication of subterranean insects but it also might be destructive to lawns, golf links, and similar areas that man wishes to leave undisturbed.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Insectivora. Family Soricidae. SHREWS

Short-tailed Shrew
Blarina brevicauda

Length 5 in., tail 1 in. Sexes superficially alike. Form stout. Tail short. Ears small. Fur velvety. Legs short. Feet not suitable for digging. Eyes small. Snout pointed. Dark slate-colored above, paler beneath. Tail black. Paler in summer. Molts in

March and October. Teeth: $I \frac{4}{2}$, $C \frac{1}{0}$

$P \frac{2}{1}$, $M \frac{3}{3}$. Tracks: $F \frac{3}{4} \times \frac{3}{4}$, 4; $H \frac{1}{2} \times \frac{1}{2}$, 5.

Found in fields and wooded areas where there is a loose vegetation over surface of ground which may harbor food. Ranges throughout eastern half of North America and is represented by more than half-dozen subspecies.

4-8 young born 21 days after breeding; at birth like wrinkled pink honeybee; at 36 hours, $1\frac{1}{2}$ g., 31 mm., no hair; at 4 days, $3\frac{3}{8}$ g., 48 mm.; at 8 days, $6\frac{1}{2}$ g., 61 mm., has short hair and can crawl; at 10 days, $7\frac{1}{2}$ g., 68 mm.; at 13 days, 9 g., 73 mm.; at 17 days, $9\frac{3}{4}$ g., 85 mm.; at 19 days, $9\frac{3}{4}$ g., 91 mm.; at 22 days, weaned. Half-grown in 1 month. Mature in $\frac{1}{2}$ year. Aged at 16 months.

Food of 244, by bulk, 47.8% insects, 11.4% plants, 7.2% worms, 6.7% crustaceans, 5.4% mollusks, remainder miscellaneous. Active year round, night or day. Nest kept clean; made of grass in dry underground cavity 8 in. across, 6 in. deep, with 2- by 3-in. center. Mates for season. To 4 litters. Some food storage. Poor sight.

Useful insect destroyer. One New Brunswick record shows it killing 60% of year's crop of larch sawfly. Takes little grain. Killed by cats and other predators but not commonly eaten because of odor. Worthy of more protection than it gets. Difficult pet. Reputed to have poisonous bite with poison similar to that in cobra.

Common Shrew
Sorex cinereus

Length to 4 in., tail $1\frac{3}{8}$ in. Weight, that of a penny, $3\frac{3}{8}$ g. Sexes superficially alike. Brown above, sprinkled with lighter or darker hairs, grayish to buff beneath. Eyes minute. Ears nearly hidden in fur. Feet not modified for digging like those of moles. Tail yellowish-brown, slender. Teeth:

colored, $I \frac{4}{2}$, $C \frac{1}{0}$, $P \frac{2}{1}$, $M \frac{3}{3}$.

Found on forest floor, in open fields and elsewhere though most commonly on ground through most of North America. Not infrequently found even out on ice floes but more normally found in wooded areas or fields where food may be abundant.

Females tolerate males except when bearing young. 5-9 young to a litter, born probably about 3 weeks after breeding, which may take place over long period. 1-day-old young, hairless, $\frac{1}{8}$ in. long with $\frac{1}{8}$ -in. tail, about $\frac{1}{8}$ g. weight of mother. To 3 litters a year.

Food mainly insects, worms, salamanders, and other small animals, eating $3\frac{1}{4}$ times its own weight daily. Sense of hearing intense, of sight poor and limited to short distances, of smell poor. Wastes not put in heaps as some mice do but not dropped near food. Can jump 4-5 in. standing, or 6 in. (?) running.

Highly useful as destroyer of insects. Held in superstitious awe by Eskimos. May carry some mite parasites and believed to carry spotted fever, but this probably not to a serious degree over any great range. Probably not as vicious or quarrelsome as it is reputed to be. Probably not long-lived. Little poison in bite.

Water Shrew
Sorex palustris

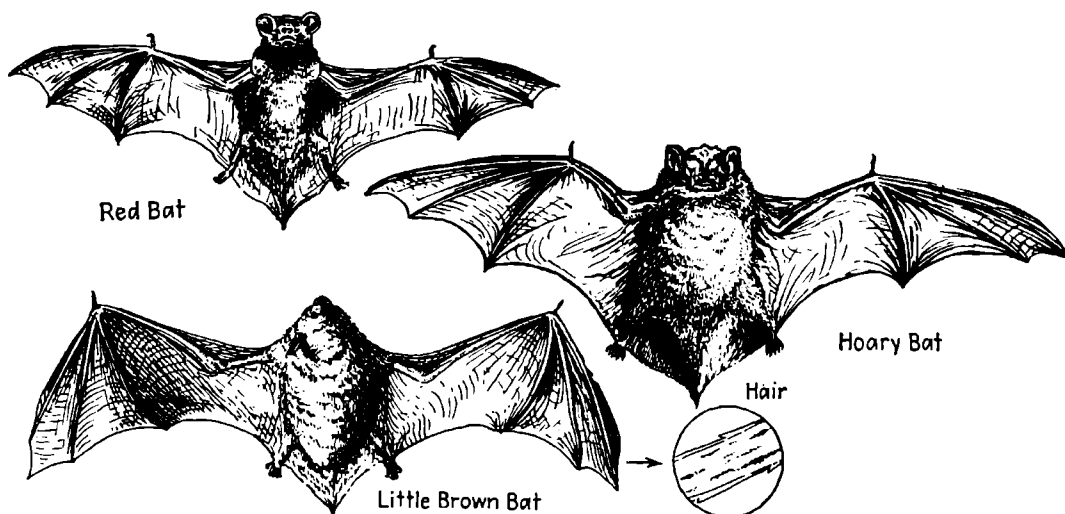
Length total, to $6\frac{3}{8}$ in. for either sex. Long-tailed, suitable for life in water, with hind feet especially large and broad, with third and fourth toes fringed by hairs and somewhat webbed. Little seasonal or age variation. Upper parts gray, with some hairs white-tipped, and under parts of body and tail white.

Ranges through colder North America as represented by 5 subspecies: Nova Scotia, Great Lakes, Rocky Mountain, Richardson (Rocky Mountains to Minnesota), and White-chinned (Pennsylvania to Labrador), and by closely related Alaska and Unalaska water shrews.

Little is known of the life history and habits. Probably about 6 young in a litter, but where and when they are born is not common knowledge. Probably 2-3 litters a year.

These shrews frequent shores and streams, living most of time in water. Their close water-repellent fur keeps skin dry and their fringed hind legs make swimming a simple problem.

These shrews probably are of little economic importance. Eskimos believe that crossing shrew's trail brings bad luck.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Chiroptera. Family Vespertilionidae. BATS

Red Bat

Lasiurus borealis

Length $4\frac{1}{2}$ in., tail 2 in., forearm $1\frac{3}{8}$ in. Conspicuously red. Relatively long-haired. Ears low, broad, and rounded. Males orange-red, female dull frosted chestnut. Under parts paler and less red than upper parts. Individuals vary in color slightly.

Teeth: I $\frac{1}{3}$, C $\frac{1}{1}$, P $\frac{2}{2}$, M $\frac{3}{3}$

Found about towns and near openings in woodlands often appearing in houses, barns, and churches. Common through North America south of Canada, probably migrating to the south during cold weather, although there is a record of hibernation in this species. Goes south to Panama and north along Pacific Coast to Sitka.

Apparently females congregate at time young are born. Mate probably in August in flight but true fertilization takes place in spring. Commonly 2-4 young born in June. Only 1 litter, young being carried hanging to breast of female or left hanging while mother seeks her own food. Development probably somewhat like that of brown bat. Independent at 3 weeks.

Food exclusively insects, captured on wing, usually $\frac{1}{2}$ - $1\frac{1}{2}$ hours after sunset and before sunrise. May migrate at heights of 150-400 ft. in open flocks and has been found 240 miles at sea. Probably guides relatively slow flight by sound beam reflecting echoes. Gentle if handled quietly. Food $3\frac{1}{2}$ g. nightly. Has homing instinct.

Useful insect destroyer. In captivity, may be fed mixture of bread, American cheese, chopped hard-boiled egg, bananas, cottage cheese, unsalted vegetables and clabber rather than sweet milk. Broken up grasshoppers and June beetles help prevent diarrhea. Brown bat may take slightly more than red bat.

Little Brown Bat

Myotis lucifugus

Length $3\frac{3}{8}$ in., tail $1\frac{1}{2}$ in., forearm $1\frac{1}{2}$ in. Face hairy. Ears narrow. Hair relatively long and soft. Sexes colored alike; little seasonal color change. Dull brown above and lighter beneath. Voice a fine, high-pitched squeak, inaudible to many ears. Weight of a nickel.

Found in various types of places, over water, near clearings, or in houses or other buildings sleeping or hibernating in caves and mine shafts through most of North America. Found far at sea. Around 30 recognized subspecies. Has homing instinct and will return to over 160 miles. Over 2,000 kinds in the world.

Mates promiscuously in fall; true fertilization thought to be delayed by plug which prevents entry of sperms until spring. Young weighs $1\frac{1}{2}$ g. at birth about 5-9 days, nurses 3 weeks. Litters, commonly 1. Females and young congregate separately from males during brooding period. Males breed at 14 months, females at 10 months. Fly at 3 weeks.

Food entirely insects, caught on wing during erratic flight where contact is avoided by echo of high-pitched (50,000-98,000 c.p.s.) sound given constantly while flying. 25 per sec. in open, 50 per sec. in trees. Most active 1 hour after sunset and 1 hour before sunrise. May fly 30 miles from home roost seeking food. May roost with other bat species.

Useful as insect destroyer. Body parasites includes fleas which do not favor men as hosts. Guano, or manure of bats, is valuable as fertilizer. At Mitchell Lake, Texas, 4,558 lb. of fertilizer worth \$200 was produced in 1 year. Young have sharp teeth. Life span at least 10 years.

Hoary Bat

Lasiurus cinereus

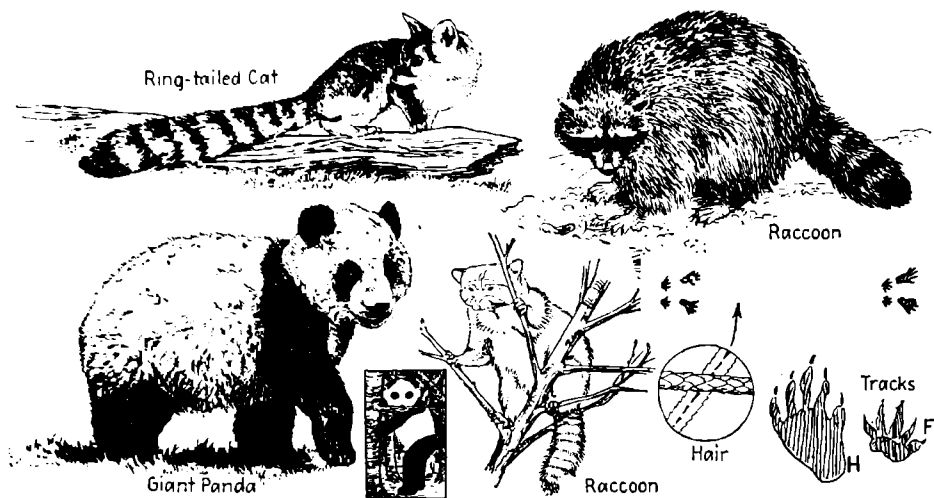
Length $5\frac{1}{2}$ in., forearm 2 in., wing expanse 16 in. Upper parts a beautiful grayish-white, changing as dark underfur is exposed. Yellowish beneath. Membranes of wings brownish-black. One of most beautiful of bats and well worth knowing more about. Female weighs about 34 g.

A high-flying, late-flying, woodland bat haunting openings in woodlands and near waterways ranging from Gulf of St. Lawrence to Great Slave Lake and south to southern Mexico, spending colder seasons in southern part of range, to which it migrates. Summers usually north of Pennsylvania, winters south of it.

Mates probably in late July-August, but young not born until following May, much as in some other bats. 1 litter a year. 4 or more commonly 2 born to a litter. Females tend to congregate at time of bearing young. Young may be hung up in holes in trees while mother seeks food. Independent at 1 month.

Food exclusively insects caught on wing, usually of the late, high-flying type. Most active during second hour after sunset and next to last hour before sunrise. Migration to south in all probability begins with early frosts. Roosts more commonly in trees than in caves or in buildings.

Undoubtedly wholly useful as a destroyer of insects. Because of its late-flying habit is little known, so any observations on its behavior may be interesting to science. No reason why this beautiful animal should be killed at any time.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Carnivora

Family Bassariscidae

Family Aeloridae

Family Procyonidae

Giant Panda

Aelopus melanoleucus

Length to 4 ft. Weight around 300 lb. Conspicuously black and white, this serving as protection in contrasting snows and shadows. Fur thick and dense. Feet flat like those of a bear. Ears relatively short. Tail remarkably short. Skull broad. Snout relatively blunt. Claws long.

Native of bamboo forests in mountains of western China, near border of Tibet, at elevations of 6,000–12,000 ft. Known to zoologists since 1869, and while originally thought a bear, now believed, because of teeth, closer to the raccoons. Ancestry probably dates back to Lower Pleistocene. No near relatives.

Mates in spring (?) and young born in January. By April, cub has milk teeth. Weighs 3 lb. when about 6 (?) weeks old and weighs about 70 lb., at 1 year, having gained about 5 lb. a month, on average. Probably becomes mature at from 4–10 years of age though this is not known. Male roars loudly in breeding season.

Food believed to be solely bamboo sprouts, requiring nightly feeding for about 10–12 hours to supply the needs of such a large animal. In captivity, eats regular baby diet of cereals, milk, vegetables, orange juice, and cod-liver oil. Claws imply that it may eat fish in wild but this has not been demonstrated.

One of most popular of unusual zoo animals, one keeper in New York zoo saying that for every person who asked him about an aardvark, 30,000 asked him where the giant panda was to be found. Antics amusing because of playfulness and grotesque appearance. Popularity should increase with knowledge.

Ring-tailed Cat, Civet Cat

Bassariscus astutus

Length 32 in., including 17-in. tail. Weight 2½ lb., with female somewhat the smaller. Trim and more slender than raccoon, with small head and large ears. Sexes colored alike, and little seasonal change. 5 slender, partly retractile toes on each foot. Tail bands white and black. Teeth:

$I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{2}{2}$

Found in wooded and rocky areas in southern United States, from Texas to the west including 3 recognized subspecies: one ranging from Oregon south through California, one in Nevada, and the third from New Mexico, Arizona, Colorado, and Utah east through Texas and rarely to Alabama.

In May–June, 1–5 young born in den, usually in hole in hollow tree. Young colored much like adults, blind, deaf, helpless, pink with whitish fuzz and stubby tails. Eyes open at 4½ weeks, travel at 2 months, and weaned at 4 months. Probably sexes congregate at different times of year but animal not normally social.

Food chiefly small mammals, birds, and insects with some fruit included. Almost exclusively nocturnal, sleeping safely in den during day. Prey to great horned owls but is usually too active to be captured by preying animals. Den entrance frequently shows signs of being chewed.

Probably serves usual function of preying animals. Fur has a good commercial value and is known to the trade as "California mink" or "civet cat." The name civet cat is improperly applied to this animal, as it properly belongs to certain Old World animals. Fur durability, 40% that of otter.

Raccoon

Procyon lotor

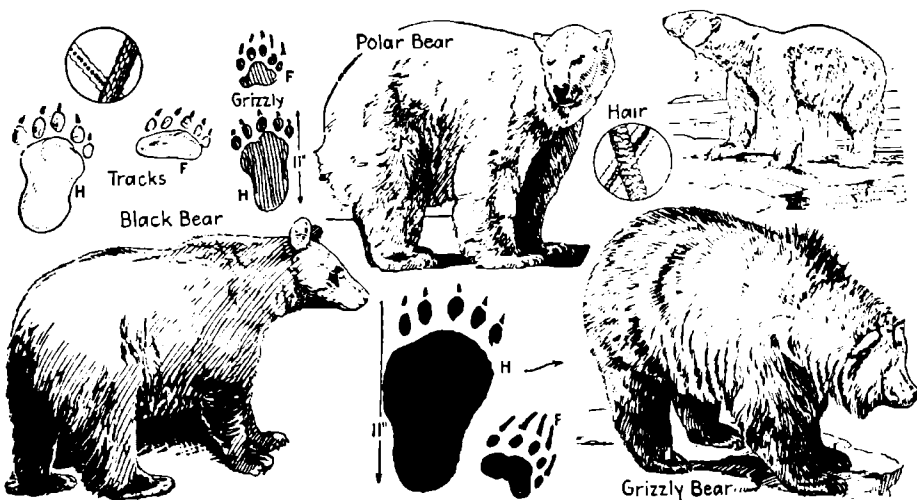
Length 30 in. Tail 10 in., bushy and ringed. Weight 15–25 lb. Sexes superficially alike. Fur long, of excellent quality; gray, brown, and black, dull brown at base. Conspicuous black band across face and eyes, and 6–7 black rings on tail. Feet with 5 slender finger-like toes front and back, yellowish-gray. Teeth: $I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{3}{2}$

Found in wooded and well-watered areas from Gulf of St. Lawrence to southeastern British Columbia, south to Gulf of Mexico and South America. Not in northern Rockies or drier parts of Great Basin including most of Montana, Idaho, Wyoming, Utah, Nevada, western Colorado, and northwestern New Mexico. 200 acres woodland gives sustained annual yield of one.

Probably monogamous. Breeds in February after hibernation. 2–6 young born 63 days later. Male helps rear young, though in captivity may kill them. Young blind for 19 days; suckle for 2 months; remain in family circle through winter; to 12 lb. by winter. May breed when 1 year old or wait until new litter forces last year's family from home den. Tracks: F $2\frac{1}{2} \times 3, 5; H 2\frac{1}{2} \times 4, 5; S 7; L 20$.

Food, insects, aquatic animals, corn, and vegetables. Den preferably a hollow tree but sometimes a cave. Does not store food nor keep den clean though it washes food if water is available. Highly inquisitive and sociable. Desperate fighter when cornered but easily tamed if caught young. Makes excellent pet. Full meal equals ½ lb. of fish.

Valuable fur bearer, decreasing in abundance rapidly in much of its original range. Fur known in trade as "Alaska bear" and "Alaska sable" as well as raccoon. Durability of fur 65% that of otter. May take corn and poultry but probably more than compensated by insects and mice destroyed and value of pelt. Valuable farm forest asset.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Ursidae. BEARS

Black Bear, Cinnamon Bear
Euarctos americanus

Length to 6 ft. Height at shoulder, to 3 ft. Weight to 300 lb. Black or cinnamon with a white throat patch. Sometimes all brown, brown bear being merely a phase of black bear. Snout rather long. Tail short. Flat-footed. Inquisitive. Not normally vicious but never really trustworthy if opposed. Teeth: $I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{2}{3}$

Originally found in most of North America except eastern California, eastern Oregon, Washington, Nevada, and western Utah. 10 or more subspecies recognized, practically all confining range to wooded areas and often common relatively near centers of population, many being taken each year in such states as New York and Pennsylvania.

Mates for season only, usually in June; 1-4 young born about 7 months later. Young about 8 oz., blind, practically helpless. Mother commonly in winter sleep. Remain with mother until fall at least, being protected by her and shown how to live successfully. Female bears young every other year, after maturity is reached. Life span to 25 years.

Food, flesh, fish, fruits, and vegetables, being particularly fond of berries. Builds up reserve of fats for winter sleep. Individuals range some 30 miles. Den in a cave or hollow stump, occupied chiefly in winter and when young need protection. Serves as a useful check on many small species of animals. Sounds, a growl, a snort, and a smacking of lips. Tracks: $F 3 \times 4, 5; H 4 \times 7, 5$.

Probably useful for hide, meat, and sport. Individuals may be harmful as destroyers of sheep, pigs, or chickens. Serve in some places to attract tourists. In zoos, bear den is always crowded by visitors who enjoy watching antics of these animals. May be trained to some degree to perform in circuses. Should not be exterminated. Fur durability, 85% that of otter.

Polar Bear
Thalarctos maritimus

Length to 11 ft. Weight to 1,700 lb. Average male 900 lb., female, 700 lb. Shoulders less heavy than in black bear. Sexes colored alike, uniformly white with suggestion of yellow; in summer, some brown appears. Young whiter than adults. No conspicuous seasonal change. Height at shoulder to 5 ft. Teeth: $I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{2}{3}$

Through Arctic America, near sea, in which it swims easily and powerfully or on ice where, because of color, it is inconspicuous. May come as far south as Newfoundland with drifting ice, also found on Greenland and Iceland. Has been found 200 miles from land swimming vigorously.

Mates in midsummer, not polygamous. 1-4 young born at 9 months, about size of rats, practically naked. Mother remains in den nursing young until March and probably breeds every other year, young being $\frac{2}{3}$ grown by mating season. Young mate when 2½-4 years old. Aged at 33 years.

Food, seals, fish, shrimps, mollusks, seaweed, small land animals, grass, and other vegetation, these being sufficiently abundant in long summer so that the animal may put on good reserve of fat. Grass eaten much as a hog grazes. Makes powerful fighter but normally will not attack unless bothered. Can scent food or enemies 20 miles (?).

Fur excellent. Animal valuable as zoo animal but Eskimos use flesh, bones, and hide for food, clothing, and utensils. Loyalty between members of the family is exceptional and exemplary, particularly between mother and young. Worthy of protection against extermination.

Grizzly Bear
Ursus horribilis

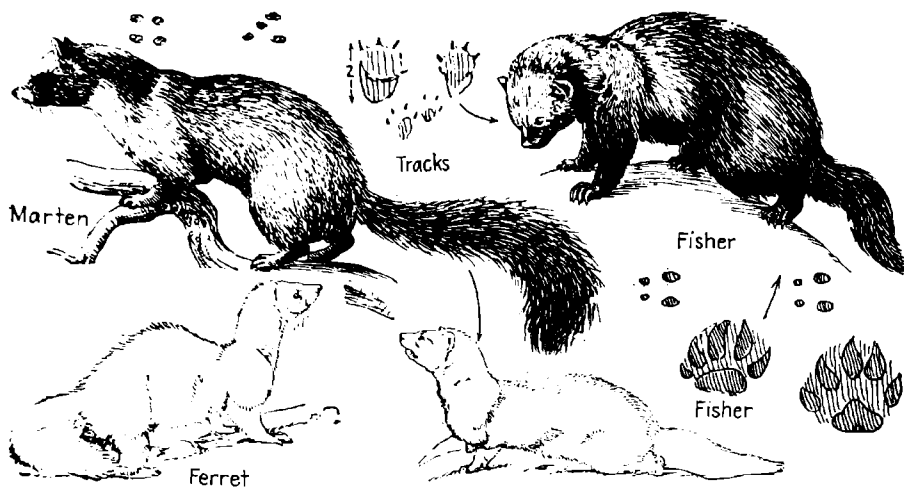
Length, male to 8½ ft. Shoulder height, to 4 ft. Average weight to 900 lb., but individuals known to reach 1,150 lb. Females slightly smaller than males. Sexes colored alike, yellowish-brown with a gray wash. Obviously of heavier build than black bears. Teeth: $I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{2}{3}$

Originally ranged through most of western half of United States and western third of Canada but now practically exterminated from United States, some 86 different forms having been recognized by zoologists. Favors rough country, usually wooded. Closely related to Alaska brown bear, a subspecies.

Probably not promiscuous, but pairs for season only. 2-4 young born 236 days after breeding, weigh 1½ lb. at birth, 8 in. long; in winter den with mother who suckles there. At 3 months, weigh 12 lb.; remain with mother during first summer. Young born every other year. Breed at 3 years age. Life span 25 years.

Food, animals such as deer, colts, cattle, sheep, fish, snakes, birds; also grass, roots, fruits, and many other things. Particularly favors gophers and ground squirrels but also may develop habit of killing domestic stock, thereby making enemies of men. Generally minds own business unless crossed, then fights. Tracks: $F 4 \times 6, 5; H 5 \times 12, 5$.

Because of cattle destruction, has been practically exterminated in United States except in national parks. Possibly this is for the best. Flesh is considered good and pelts, because of rarity, may be worth over \$100. Park animals always draw tourists at feeding time and for most part are well behaved.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Mustelidae. WEASELS

1. Domestic Ferret
Mustela fure

2. Black Ferret
M. nigripes

(1) length 12-14 in. plus a 5-in. tail. Eyes reddish. Yellowish-white. Smaller than polecat, of which it is sometimes considered a variety. (2) Length 18 in. plus 5-in. tail. Yellow-brown with face, throat, and under parts nearly white; with black mask across eyes, blackish-brown feet and end of tail. Female 10% smaller than male. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$.

(1) originated in Africa but introduced into Spain, then throughout Europe and then through civilized parts of world. (2) found in Great Plains region of North America, from western North Dakota to northern Montana, south to Texas but exceedingly rare, and almost extinct over most of its original range.

(1) 5-8 young born in captivity twice a year, with mother protecting them well. (2) little known about breeding habits of black ferret except that family of mother and young may be seen working together late in summer and nest is probably underground in a prairie-dog tunnel.

(1) food primarily rats and mice, rabbits, and similar small animals caught by following them through their burrows. In captivity, ferret is fed on milk and bread with some raw meat added now and then. (2) the black ferret lives in prairie-dog towns and feeds mostly on animals that dig burrows in which it lives. It will often exterminate a town's life.

(1) used by hunters to drive rabbits from their underground retreat, rabbits being caught in a bag or hands as they dash from burrow. Also used to exterminate rats in buildings. So effective in all dealings with their food that their use is regulated by law where rabbits are not abundant. (2) useful as a natural check on destructive prairie dogs.

Marten, Sable
Martes americana

Length total 25 in., tail 8 in. Weight to 4 lb. Rich dark brown with irregular patch on throat, though color varies and throat patch may be white or orange. Ears white or dull inside, pointed. General appearance much like a slender snaky squirrel but more active in treetops. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$,

P $\frac{4}{4}$, M $\frac{1}{2}$. Tracks: F $\frac{3}{4} \times 1\frac{1}{2}$, 5; H $1\frac{1}{4} \times 2$, 5; Sp, 4; L 36.

Tireless hunter of treetops night or day. Found through wooded Canada and Alaska, formerly south in Alleghenies to West Virginia, in Rockies to Colorado and, on West Coast to central California; also established in groups in Colorado and northern New Mexico. Now generally rare.

Possibly pairs, mating in July-August. 1-5 young born in April in grass-lined hollow tree or burrow; reared by mother only; blind, 6 weeks; suckled about 5 weeks, reach adult weight in 3 months; only 1 annual litter. Not sociable as family or groups of families. Life span 18 years. Gestation 9 months.

Food, squirrels, rabbits, birds, mice, eggs, or any animals that can be overcome. About only protection a squirrel has is to get into hole too small for marten to enter, as it can be outrun in treetops. Generally found in evergreens or second-growth hardwoods. Food may be available through year. No hibernation.

Valuable as destroyer of injurious mice and other rodents; mice never become pests in marten country. Highly valuable fur bearer, generally becoming scarce. In good country, 6 martens per square mile would be high population. Has recently been successfully raised in captivity and may be therefore saved as fur source. Fur durability, 60% that of otter.

Fisher, Pekan
Martes pennanti

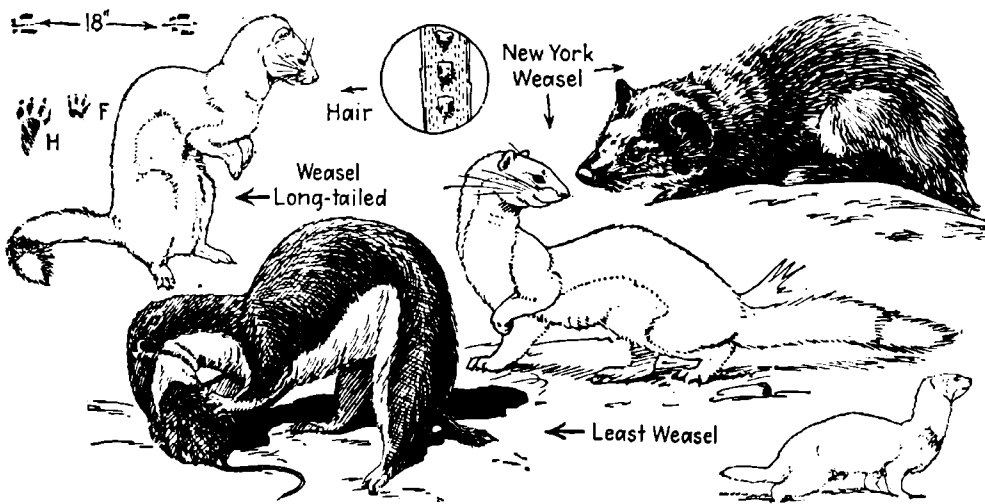
Length 3 ft., tail 14 in. Weight, male to 18 lb.; female to 6 lb. Dark-brown to blackish, with legs and tip of tail black. Female smaller. Both have general appearance of a slender, long-nosed, short-legged black cat. Possesses great agility and activity in treetops. Gives off foul scent when annoyed. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{1}{2}$.

Found in dense wooded areas of North mainly north of Gulf of St. Lawrence to northern Quebec, northern Ontario, Manitoba, Saskatchewan, Alberta, and British Columbia and south in mountains to central California and northern Appalachians. Absent in plains of southern Canada and of northern United States.

Possibly pairs, mating in March, with 1-5 young born 338-358 days later, with new breeding about 7 days later. Young blind 7 weeks; in den to 3 months; reared by mother alone, with homes a series of dens in hollow trees with a high 4-5-in. entrance. Family breaks up early and moves about, ranging over 8-10-mile territory. Not sociable.

Food, squirrels, martens, mice, porcupines, raccoons, birds, and other warm-blooded animals captured by tireless pursuit. Reserve food supply may be hidden. Obviously has certain beats which may be followed day or night. Does not burrow as do many close relatives. Mischievous. Growls, snarls, spits, or cries mournfully. Easily trapped.

A most valuable fur bearer, single pelts having brought as much as \$150. For some 70 years over its entire range yield has averaged around 8,000-9,000 pelts a year but is now dropping dangerously. Protected completely in some states. Pelt of female is about twice as valuable as that of male. Tracks: F $\frac{3}{4} \times 2\frac{1}{2}$, 5; H $1\frac{1}{4} \times 2$, 5; Sp 4; L 36.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Mustelidae. WEASELS

Long-tailed Weasel
Mustela longicauda

Length to over 18 in. with a 6-in. tail and a 2-in. hind foot, with female about $\frac{3}{4}$ size of male. Distinguished by size, long tail, and brownish-yellow rather than sulfur-yellow or white under parts. In winter this species is pure white except for tail tip. Not illustrated above.

Continues range of New York weasel, beginning somewhat farther west and extending from Kansas through Great Plains to Manitoba and Saskatchewan. Lives in open prairie country, often making a prairie-dog town a center of operations.

Life story is probably similar to that of other weasels. Apparently, family stays together a long time and a number of families may live relatively close together if food is abundant.

Weight of this animal may be nearly twice that of a normal New York weasel. It may leap 40 in. and is powerful enough to attack and kill a pocket gopher or a snowshoe rabbit. It has been known to attack man when cornered and, once infuriated, to persist in its attack. Through persistence, it can run down a snowshoe rabbit.

Important check on grass eaters in great grazing areas and difficult to consider as a pest except where poultry is kept unguarded. Without coyotes, weasels, hawks, and owls to kill squirrels and rabbits, there would be little forage for cattle. Pelt not of high quality.

Least Weasel
Mustela erminea

Length, female 6 in., tail $1\frac{1}{2}$ in. Smallest of the weasels. Tail with sparse black tip. Upper parts uniformly dark red-brown, under parts white. All white in winter, including tail tip.

Found in woods, lawns, waste places from Hudson Bay to Alaska, south to Montana and Minnesota, east into Ohio and Pennsylvania, with related species extending range as well as sharing it. Southern limits probably Kentucky and Pennsylvania, Iowa, South Dakota, and a short way south in Rocky Mountains.

Little known about home life except that young are born and cared for in a dry clean well-aired underground den, usually lined with grass or hair. Young, 3-6. Probably solitary except for fact that the families remain together during summer months. Young born at widely different seasons.

Food mice, shrews, and insects, often providing a real fight. Enemies are many, including birds of prey and larger animal eaters. Hunts by scent; climbs and swims easily when seeking prey. Will stay on a trail persistently until food is caught.

Unquestionably useful as destroyer of many insects and particularly of mice, which are of course destructive to plants raised as food for man. Little is known about these animals, so all observations of them should be recorded carefully and sent to some interested zoologist.

New York Weasel
Mustela vison

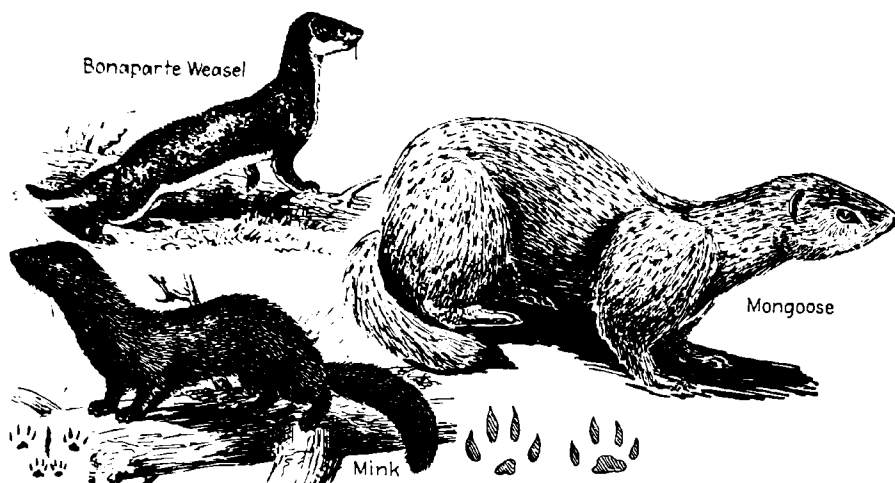
Total length, males to 24 in., females to 13 in. Tails of males to over 6 in., of females to over 4 in. Hind foot, of males to 2 in., of females to $1\frac{1}{2}$ in. Tail long and bushy and black for $\frac{1}{2}$ - $\frac{3}{4}$ its length. Weight to 12 oz.

Found from Maine to North Carolina and western Illinois, with darker variety, known as "southern weasel," *M. noveboracensis notia*, only slightly larger and ranging from North Carolina to District of Columbia. Northern long-tailed weasel *M. occisor*, to 18 in. long. Florida and Washington weasels resemble this species.

Probably mate in midsummer but young are not born until following spring. Pair cooperate in rearing of young, male bringing food when it is needed. May pair for life. Young may average 4. Life history probably much as outlined for Bonaparte or small brown weasel.

Merriam contends that this species has evolved from Bonaparte weasel. It ranges over 100 acres a night in search of food, mostly mammals to size of rabbit and mainly mice but also birds, frogs, snakes, and insects. Can hold a 200-g. rabbit free from the ground. Tracks: F 1×1 , 4; H $\frac{1}{2} \times 1\frac{1}{2}$, 4.

Of major importance as a control of mice and deserves reasonable protection as a mouse and rat destroyer. Canada yields about 500,000 weasel pelts a year. In summer dark-brown above and white with yellowish wash beneath. In winter animals are white (ermine) with females more prone to change than males in border territory. Changing animals are known to trade as "graybacks."



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Mustelidae. WEASELS

Bonaparte Weasel
Mustela cognatus

Length, male 11 in., tail $3\frac{1}{2}$ in.; female 9 in., tail $2\frac{1}{2}$ in. Toes on each foot, 5. Soles of feet furry. Soft close underfur and glistening chestnut outer hairs. Brown above and white beneath in summer. All white, except black tail tip, in winter. Strong odor. Sexes and young colored alike.

Found in cultivated farmlands, woodlands, and waste places from just south of Great Lakes almost to northern border of the continent and west to Pacific. South along Rockies and Sierras to central Wyoming and central California, place being taken in these western areas by closely related species.

Mates probably in July; later (sometimes $8\frac{1}{2}$ months), 4-8 young are born. Young blind for 5 weeks; weaned at 6 weeks; sometimes cared for by both parents and hidden in clean den lined with fur of animals which have been killed. Will defend young at risk of own life. 1 litter a year. Family life exemplary.

Food of 360 individuals, 34.5% field mice, 13.1% rabbits, 11.3% deer mice, 11.2% shrews, 6.7% rats, 3.6% chipmunks, 3.2% birds, frogs, and snakes, and 16.4% undetermined mammals. Among 500, no evidence of bloodsucking. Active mostly at night but seen in open night or day through year. Tremendously active and interesting.

Splendid destroyer of harmful mice; kills also millions of rats and other rodents yearly. Reputed to break up game-bird nests. Pennsylvania has spent over \$500,000 (\$80,000 in 1937) in bounties at \$0.50-\$1 a head and number taken still increases. Prime pelt has brought \$1-\$2. Probably much more good than evil agriculturally.

Mink
Mustela vison

Length to $25\frac{1}{2}$ in., tail $8\frac{1}{2}$ in. Weight, male to $3\frac{1}{2}$ lb., female to $1\frac{1}{2}$ lb. Tail bushy. Sexes alike, a rich dark brown with white under chin. Nose pointed. Ears small and set close to head. Toes, 5 on each foot. Tracks paired. Runs by rapid leaps. Well-developed scent glands.

Found through most of Canada and Alaska except in extreme northern treeless border; south through most of United States except Texas, New Mexico, Arizona, southern Nevada, and southern California. Usually in wooded areas near waterways but may roam inland considerable distances. Swims well.

Mates in February-March, both males and females taking one or more mates during season. Males fight fiercely. 3-8 young born 42-44 days after breeding, sometimes much longer; blind $3\frac{1}{2}$ -5 weeks after birth, helpless. Leaves den, usually at end of a tunnel 4 in. in diameter, when 6-8 weeks old. 1 litter a season.

Food mostly rats, mice, fish, and poultry. May be severe enemy of marsh-dwelling birds. Also eats young snapping turtles which prey upon birds and fish. Does not kill wantonly and though it can climb, rarely does so. Family of mother and young remain together during first summer. Tracks: F $1\frac{1}{2} \times 1\frac{1}{2}$, 4; H $1\frac{1}{2} \times 1\frac{1}{2}$, 4; Sp 5; L 24.

Value of fur more than compensates for game destruction. One of most valuable fur bearers, prime pelts sometimes bringing \$25. Durability of fur: natural 70%, dyed 35% that of otter. Can be raised in captivity, those so raised constituting around 40% of total annual American crop. Interesting cage animals.

Golden-brown Mongoose
Herpestes javanicus

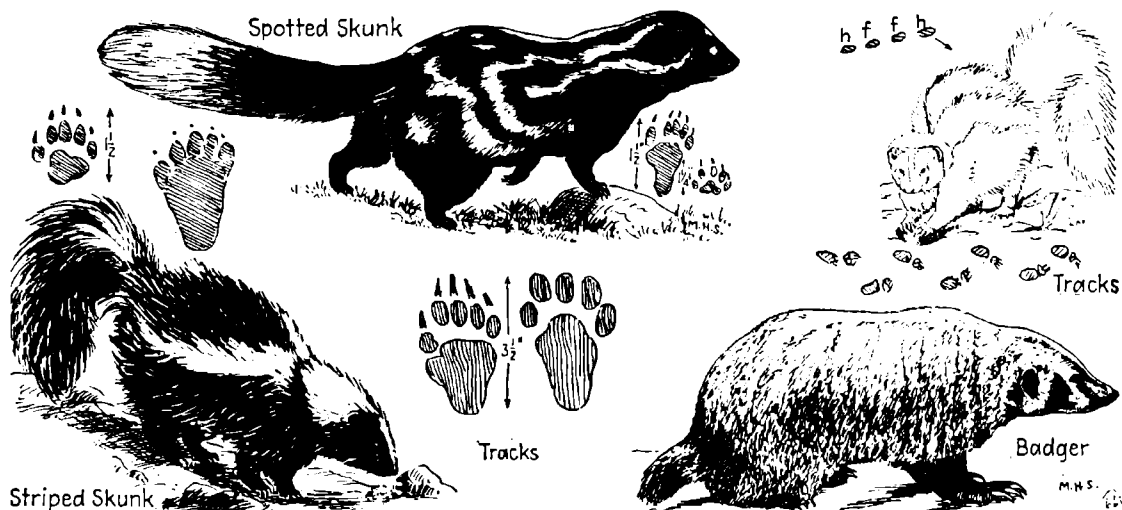
Length, body 15-18 in., tail 14-15 in. Rather stout and weasel-like with short legs, pointed muzzle, short rounded ears, and 5-toed feet with long non-retractile claws. Tail thickest at base and tapering to end. Grayish or reddish-brown, lighter beneath. Can stand erect on hind legs. Quick, active, bold.

Native range of Indian mongoose, India and Ceylon. Java mongoose introduced into Jamaica in 1872. 72 descendants of these introduced into Hawaii in 1884. African species include white-tailed, red-tailed, and Caffre; a Spanish species; Asiatic group: short-tailed mongoose, *H. dorachyurus*, Malaya, Borneo, Sumatra, length 30 in.; Hosis mongoose, *H. hosei*, Borneo, smaller; Colland mongoose, *H. semitorquatus*, Borneo, length 25 in.; crab-eating mongoose, *H. urva*, China and Formosa, length 29 in.

In Hawaii, newborn young are found in all months except October, November, and December. 2-3 litters a year, with 2 or rarely 3 young per litter. Young are protected apparently by mother until they are $\frac{1}{4}$ grown, frequently going about hiding under her body or tail. Nest in hole.

Food is largely animals such as birds, reptiles, insects, and rats. They are great snake destroyers but are not immune to the bite of venomous snakes, which they kill with skill and agility, usually breaking snake's neck after he has struck. Animal is rather easily tamed and becomes very affectionate.

Useful as a destroyer of rats and venomous snakes and of insects but also highly destructive of ground-nesting birds and of poultry. Cannot climb trees, and in mongoose country rats have taken to living in trees. Because of poultry killing and other bad habits cannot be introduced legally into United States.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Mustelidae. WEASELS

Common Skunk
Mephitis mephitis

Length 30 in. Tail $7\frac{1}{2}$ in. (male), $6\frac{3}{4}$ in. (female). Weight to 10 lb. Fore claws good for digging, not retractile. Sexes superficially alike, either all black or black with conspicuous white stripe down back and onto tail. Strong, repulsive scent characteristic. Tracks: F $1\frac{1}{2} \times 2$, 5; H $1\frac{1}{2} \times 2\frac{1}{2}$, 5; St 5. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$.

Found in woods and plains, near towns or away from them, where there is loose soil. From southern half of Canada, south nearly throughout United States except for southern tip of Florida and parts of Coastal Plain. May be near water or in dry open country, almost desert-like.

Mates February–March, after family of preceding year breaks up. In 51 days, 4–10, naked, blind (3 weeks), and almost helpless young are born, in a den which may be occupied by other animals. Nurses for 6–7 weeks. Male may rejoin family after young are partly grown, but not with family before July, when young are in earlier stages.

Food: 414 analyses show 41.3% insects, 22.1% fruits and berries, 14.1% mammals, chiefly mice, 12.9% grains, 5.4% carrion, 2% birds, 2.2% unidentified. Female may seek blood about time young are born. Particularly destructive to potato beetles, hop miners, turtle eggs, white grubs, and other pests. May take some poultry.

Was used as food by Indians. Valuable to man as destroyer of vermin; as fur pelt, more than compensates for injury caused to game and poultry. Fur has durability 70% that of otter, sells under trade name of Alaska sable and black marten. Can give scent even if held by tail but does not cause blindness.

Little Spotted Skunk
Spilogale putorius

Length, male $22\frac{1}{4}$ in., tail $8\frac{3}{4}$ in.; female 22 in., tail, $8\frac{1}{4}$ in. Glossy black with a white spot on forehead and 4 longitudinal white stripes on back, sides, and onto tail, more or less broken in appearance. Color pattern highly variable. Chunky. Strong odor.

Sexes colored alike. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$.

Some 13 species and subspecies north of Mexico including lower Appalachians, from Maryland through Alabama; a midwest type from Iowa through Texas; a mountain type from Idaho, Nevada, and Utah; 3 Pacific Coast types, in extreme western Washington, Oregon, and California, with others along Texas coast and elsewhere.

One male mates with many females in late winter, and 2–10 young are born in midspring in a den, in a stump, cave, stone pile, or hollow log. Parental care is probably provided chiefly by female, as is usually case in polygamous animals. Strictly nocturnal, more so than its larger relative.

Food essentially insects, mice, and small forms of animal life. It may carry rabies but so may many other animals, and chances of being bitten by a mad skunk are considerably less than chances of being bitten by a mad dog. Possibly more of an insect eater than its larger relative. May climb trees, swim, burrow, or run.

Probably essentially useful as an insect destroyer and as an enemy of mice. A full meal is equal to about $\frac{1}{8}$ lb. of rabbit flesh. Fur possibly more handsome than that of common skunk because of pattern showing broken white lines against contrasting black. Fur passes in trade under name of civet cat.

Badger

Taxidea taxus

Total length 30 in., tail $5\frac{1}{2}$ in. Weight to 24 lb., average about 13 lb. Sexes superficially alike in size and color. Grizzled gray with black, with most hairs gray at base, then gray-white, then black, then silver-tipped. Face black and white. Forefeet with powerful claws useful in digging. Teeth: I $\frac{3}{3}$,

C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$.

Dry prairie or grasslands with loose soil and many ground squirrels, from central North America south of Saskatchewan, through United States from Ohio to Washington, Texas, and California, with related species in other parts of world. Most abundant where its food species are abundant.

Probably pairs, at least for summer, both parents caring for young. 1–5 young born at 6 months, in May, in a large grass-lined nest, at end of burrow which extends some 8 ft. from entrance. Family stays together around a home possibly for year, particularly mother and young. May live 12 years.

Food, small rodents, particularly ground squirrels dug from burrows; also birds, insects, and other small animals. A full meal equals $\frac{1}{3}$ lb. of ground squirrel. Can swim or climb but burrows best, not infrequently building new burrow each day. A terrible fighter against dogs. Keeps den clean.

Unquestionably useful if prairie dogs and ground squirrels are considered as destructive. Sometimes seems to be friendly with animals of other species but justly distrustful of man, who has almost caused its extermination in certain areas. Holes may seem to destroy appearance of a cultivated field.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Mustelidae. WEASELS

Wolverine, Glutton

Gulo luscus

Length 3 ft., tail 6 in. Height 1 ft. Weight 20-30 lb. Dark blackish-brown with a pale band along sides. Stout bushy tail. Ill-odored, clever, apparently malicious and powerful, with strong claws and teeth. Ears small and relatively close to head. Teeth sharp and strong; I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$

Found in wooded areas principally but now greatly reduced in range. Formerly through northern United States and southern Canada except in Plains region but now limited rather closely to Hudson Bay region. May range as individuals over a territory 50 miles across, moving place to place as convenience suits.

Mates in spring (?), with 2-4 young born about 2 months (?) later in June; suckled by mother 8-9 weeks; cared for by mother until late summer. Little evidence that male shares family cares. Den a cavern lined with dry leaves, usually well-guarded by rocks and logs.

Food, animal matter. Known to kill deer, caribou, and bear by jumping onto back from elevation and sinking teeth into neck. Suspected of having killed small moose and puma. Food stored by denfiling it and burying it, making it useless to other animals. A primitive species, size of bear, lived 4 million years ago in western United States.

A great menace to trappers and campers, and a dangerous antagonist if cornered. Fur does not collect moisture, therefore used in parkas and around faces of aviators and those who live in Arctic. Known as carcajou, skunk bear, Indian devil, and quiquihatch. Fur durability, 70%. About 1,000 pelts a year on market, at \$16-\$25 per pelt.

Otter

Lutra canadensis

Length 4-5 ft., with 1-ft. tail. Height to 10 in. Weight to 25 lb. Feet webbed. Soles of feet hairy. Each foot with 5 toes. Tail strong and muscular. Fur rich glossy brown. Gray on lips and cheeks, lighter brown beneath. Sexes colored alike. Little seasonal or age variation. Teeth: I $\frac{3}{3}$,

C $\frac{1}{1}$, P $\frac{4}{3}$, M $\frac{1}{2}$

Usually found in or near good sized waterways, from Canada and Alaska, except in extreme northern parts, south through United States except in southern Texas, southeastern New Mexico, southern Nevada, and California. Individual ranges over 50-mile territory, going rounds regularly traveling day or night.

Probably mates for life, breeding in late February. Young born about 60 (?) days later, 1-5 in a litter; blind about 5 weeks, suckled about 4 months. Family stays together for 1 year, both parents helping in rearing of young and carrying on an ideal family life. Den in a bank or hollow log. Makes slides on stream banks.

Food mainly fish but may kill muskrats, ducks, young beavers, birds, and even poultry, caught at any time of day or night through year. Apparently can adjust well to varying light and temperature. Gives off offensive odor when disturbed. Is a match for average dog in a fair fight. Tracks: F $2\frac{1}{2} \times 3$, 5; H 3×3 , 5.

Valuable fur bearer, most durable type; natural fur considered 100% as compared with other furs. Pelts bring to \$25. Can live in zoos but apparently are not successfully or economically raised for their pelts. Natural American stock decreasing unduly though otters still survive in long-settled England.

Sea Otter

Enhydra lutris

Length to 5 ft., of which 1 ft. is tail. Weight to 80 lb. Sexes colored alike a glossy brownish-black with white-tipped hairs on head and neck, particularly on young. Fur finest quality and durability. Female slightly smaller than male. Hind feet broadly webbed, haired on both surfaces, flipper-like, about 6 in. long, and 4 in. wide. Teeth:

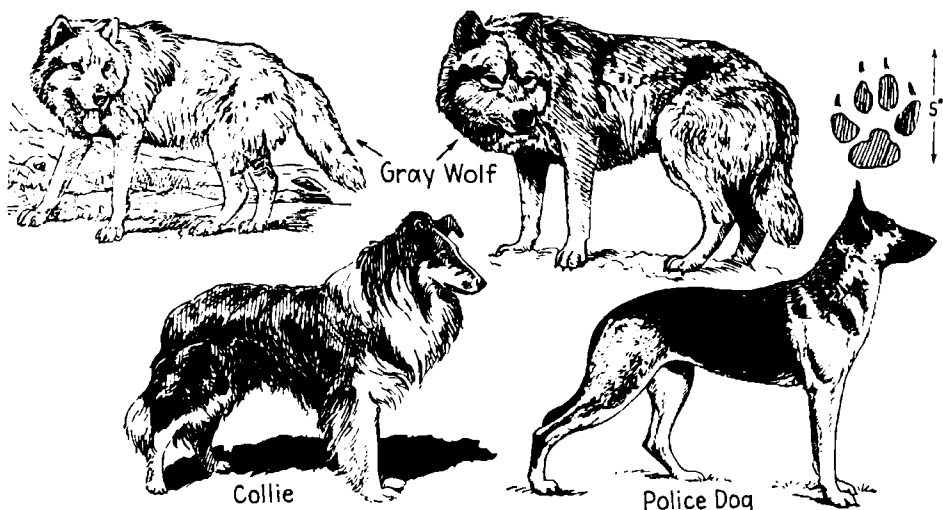
I $\frac{3}{2}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{1}{2}$

Formerly ranged through North Pacific but now practically extinct. 2 sub-species differ primarily in size, southern variety reaching a total length of 6 ft. Ranged south along shores of Lower California; until a small herd was discovered a few years ago, was considered extinct by many authorities.

1-2 young are born any month of year, 8-9 months after mating, which is preceded by an elaborate courtship. Young born with eyes open, with all teeth developed and able to get about well, yet may be suckled for almost a year and may sleep in mother's arms at sea. Young may reach breeding maturity at 1 year.

Food gathered almost wholly from sea, where adults may dive to depths of 300 ft. or more. Family life is ideal. Mother and young mourn tremendously at separation. Young may not reach full size for 4 years. Families may stay together for years, probably forming basis of the herds of old. Fur durability, 80% that of otter.

In former days, when sea otter pelts were available, better pelts averaged as high as \$2,500 apiece. Practical extinction of this superior fur bearer is an indictment of man's inability to control activities of men and other otter enemies. Restoration to reasonable abundance should be a part of world planning.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Canidae. DOGS

Gray Wolf
Canis nubilus

Length, male 64 in., including 16-in. tail; female 56 in. with 12-in. tail. Shoulder height 27 in. Male to 150 lb., female to 80 lb. Gray sprinkled with black. Legs and under parts yellowish-white. Unlike dogs, have hair between toes, slant eyes, heavy build, curved canine teeth, sharp muzzle, and dense underfur; have larger size and much smaller ears than coyotes. Teeth:

$I \frac{3}{3}, C \frac{1}{1}, P \frac{4}{4}, M \frac{2}{3}$

Originally ranged through most of North America, though present range is now probably limited largely to eastern Canada and far north country. Still found in Wisconsin and Michigan. Apparently was never established in parts of California, Nevada, Oregon, Arizona, and Utah. About 10 species and subspecies in America.

Mates probably for life, breeding January-March. 3-13 young born at 63 days; blind about 9 days, suckled 6-8 weeks, run with family for about 1 year; run in packs at various seasons of year after that. May live 15 years.

Food largely sheep, cattle, deer, and other animals, run down by packs and eaten on spot. 1 meal a week is sufficient. Some food may be stored by burying. Rarely eats any vegetable matter. One large wolf alone can bring down a full-grown steer and kill it. Pack ranges over several hundred miles. Tracks: F $4 \times 5\frac{1}{2}$, 4; H $4 \times 5\frac{1}{2}$, 4.

Wolves have probably been driven from most of United States, except in Wisconsin, Michigan, and certain protected areas. They disappeared from New Jersey last century, from the Adirondacks in 1893, and from Pennsylvania in 1907. They find little place in a stock-raising country. Fur durability, 50% that of otter.

Collie Dog
Canis familiaris

Height 20-40 in. at shoulder. Weight 40-60 lb. Long-haired, graceful, and dainty in most habits. Nose long and slender. Ears drooping, erect or partly erect at will. Colors, black and tan or rich brown, with clear white throat; some, white; others, clear bluish gray. Intelligence is not dependent on exhibition standards; few breeds show superior intelligence.

In England, Scotland, and Wales, breed has been indispensable to men who had responsibility over large herds of sheep. This value is same wherever sheep are herded in any considerable numbers. Animals vary in different parts of world but are popular wherever men like dogs.

6-12 puppies, born 59-63 days after male dog breeds with female bitch; blind, unable to hear for 10-12 days; nurse until 4-8 weeks of age, become biologically independent in less than 1 year and then able to breed, male being capable of inseminating female at any time after maturity is reached. Female in heat once a year (monoestrous) for a period of 1-3 weeks. Puberty, 7-10 months. Ordinarily mother alone cares for young. Normal body temperature, 101-102 F. Respiration, 15-20. Pulse, 70-120. Life span to 20 years.

Dog management is a responsibility which should not be shunned by a dog owner, because within certain limits a dog is what its master makes it. Punishment of dogs of intelligence need rarely be physical or cruel; rather it may be accomplished by denying dog privileges it appreciates. Don't keep a dog tied or confined more than necessary as this may make it mean. Don't tease any dog, sic it onto a person, allow it to get into a fight, or let it chase cars. A few days' concentrated effort may be worth the dog's life and your neighbor's respect. Never hit a dog with the hand, kick it, or hit it with a stick, lest it learn to fear hands, feet, and sticks and to attack them on passers-by. Make no exceptions to established rules.

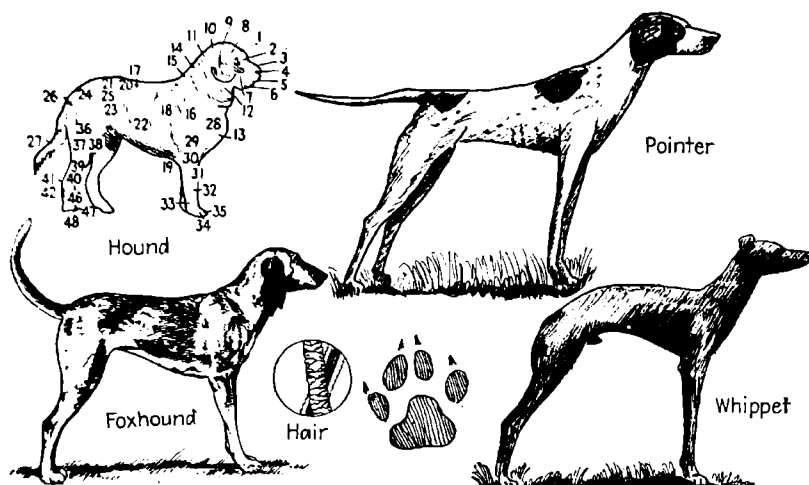
Collies have been known to herd as many as 3,000 sheep, separating them so that rams were driven into one corral, ewes and lambs into another; this in spite of the well-known tendency of sheep to stampede and follow any leader in any direction. Records of collie memories, loyalties, and unfortunate disloyalties are surprisingly interesting.

German Shepherd or Police Dog
Canis familiaris

May stand 22 in. high at shoulder. Hair comparatively long, black with a buff base. Muzzle black. These dogs resemble wolves but ordinarily lack fur between toes and dense underfur mixed with gray of wolf. Also lack slant-eyed, sharp-muzzled, curved-tusk appearance of a wolf. More powerfully built than collies and possibly more intelligent.

Developed in Europe, where an animal of exceptional intelligence was needed to do work that horses could not do. They have, unfortunately, been used both for good and for evil. Where they have not been trained, have used their own intelligence to satisfy their natural desires as preying animals. Particularly susceptible to disease when young.

Deeds of this breed include exceptional ability in helping police and as dogs of war; even more remarkable is their ability as "seeing eyes" whereby blind people enjoy freedom otherwise denied to them. They make superior actors even in sound films because they may be directed by motions rather than by words. They deserve thoughtful, responsible masters.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Canidae. Dogs

Foxhound

Canis familiaris

Medium-sized dogs, bred for ability in following trails of game by scent. Black, tan, and white, with black area usually on body upper parts, tan just below hips and on sides of head, and white on legs or replacing other colors in varying areas. Hair relatively short. Legs long, strong, and sturdy. Tail brushless. Endurance remarkable. Sense of smell phenomenal. Works well in rough country with other dogs. Kindly.

Although bred over 300 years, foxhounds retain primitive coloration. American foxhounds are lighter and more active than English breed, developed because of greater roughness of country. Closely related beagles are shorter legged, and bloodhounds are darker, heavier, and much slower, usually with little or no white; all 3 have typical ears.

Records of foxhounds show varying ability to follow trails. Bloodhounds have been reputed to be able to follow a trail 30 hours old, which foxhounds cannot do even under most favorable conditions. Foxhounds couple speed with ability to follow a fresh trail well and long, through difficult cover, and are ideal for this purpose.

Exterior parts of a dog are: Head: forehead 1, eye and eyelash 2, crest of nose 3, nose 4, mouth and upper lip 5, flews 6, cheeks 7, ear 8, ear flap 9, back of head 10. Neck: nape or poll 11, throat 12, dewlap 13, crest 14. Trunk: withers 15, upper chest 16, back 17, chest 18, under chest 19, loins 20, cross 21, abdomen 22, hindquarters 23, croup or rump 24, hip 25, root of tail 26, tail 27. Forelegs: shoulder 28, upper arm 29, elbow 30, forearm 31, wrist or carpus 32, metacarpus 33, toes 34, claws 35. Hind legs: hip joint 36, upper thigh 37, stifle of knee joint 38, lower thigh 39, tarsal joint 40, heel 41, hock 42, metatarsus 43, toes 44, claws 45.

Dog dentition: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{2}{3}$. Order of appearance of teeth: milk teeth: first and second incisors 4-5 weeks, third incisors 4 weeks, canines 3-4 weeks, first and second premolars 4-5 weeks, third and fourth premolars 3-4 weeks. Permanent teeth: incisors and canines 4-5 months, premolars 5-6 months, first molars 4 months, upper second molars 5-6 months, lower second molars 4½-5 months, third molars 6-7 months.

Pointer

Canis familiaris

Weight 44-60 lb., compared with 65-75 lb. for griffons (wire-haired pointers). Retrievers average 60-70 lb., setters 40-55 lb., spaniels 18-60 lb., cockers 18-24 lb., springers 45 lb., and clumbers 35-60 lb. Pointers are black and white or liver and white, short-haired, with strong but slender legs, large heads, long square muzzles, and compact strong bodies. They are intelligent, affectionate, hardy, loyal, and tremendously active when free.

Developed in Spain in Middle Ages, taken to France early in seventeenth century and from there to England, where they were crossed with English terrier and foxhound to reduce weight. Prize animals are lean, with keen eyes and noses, ability to learn, and plenty of stamina and courage. Tail should be straight, strong, and rigid when animal points.

Used to indicate location of game so that it may be shot by hunter and to flush it only on command, then to retrieve killed or injured bird without further injury. It uses scent as a chief means of locating game. Breed is used primarily for hunting birds. Extensive field trials are held to determine relative ability of individuals.

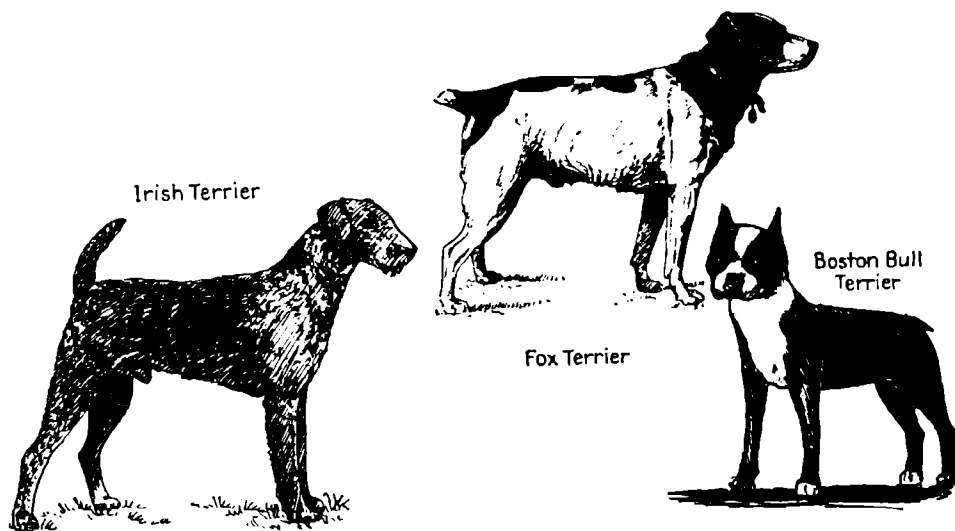
Whippet

Canis familiaris

Height 15-21 in. Weight 10-28 lb., ideal, male 15 lb., female 13 lb. Head long and narrow with pointed muzzle. Neck, legs, body, and tail slender, with tail frequently held between legs when at rest. Hair short and close. Color red, black, white, brindle, fawn, blue, or mixed, but commonly white on throat and muzzle. Judged more by performance than by appearance. May bring as high as \$4,000.

Developed in England in middle of nineteenth century, probably by crossing English greyhound, Italian greyhound, and a variety of terriers, particularly Manchester terrier. Whippet racing, poor man's racing event, has long been popular in England and is becoming so in America. Affectionate, intelligent, loyal dogs that make good pets.

In racing whippets, animal is held with front feet on starting line and hind legs off ground. At starting signal, animal is thrown into stride by handler and pursuit of real or electric rabbit is on. Usual distance is 200 yd., which has been covered in less than 12 sec., at about 52 ft. per sec. or 35 m.p.h.; this is faster than any other known domesticated animal.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Canidae. DOGS

Irish Terrier
Canis familiaris

Height about 18 in. Weight about 25 lb. Related Airedales: height 22 in., weight to 50 lb. Irish terrier red, Airedale tan or sandy with grizzled gray neck and saddle. Head at right angles on strong neck. Hair on lips and chin usually long. Holds ears down and tail up or partly over back and rather stiff. Airedale developed from otterhound and Manchester terrier, appearing about 1860 outside native Yorkshire, England.

Related Welsh terrier smaller than either Irish or Airedale; height 15 in., weight 20 lb.; black and tan. Short-haired terriers include short-haired fox terrier, bull terrier. Long-haired and generally smaller Skye terrier, Sealyham terrier, Scotch terrier, and the white West Highland terrier.

Irish terriers are essentially one-man dogs with intense loyalty to masters. Make excellent watch dogs which brook little interference. Excellent hardy hunting dogs having keen noses, and are such good fighters that they are used commonly in destroying rats and other vermin. Lack speed of some other hunting dogs. Excellent as Red Cross dogs.

Fox Terrier
Canis familiaris

Length about 2 ft., with 1-ft. tail unless it is docked. Height at shoulder about 14 in. Weight about 20 lb. 2 major subbreeds divide on long- or short-haired characters. Usually stands erect, with forelegs stiffly straight and head held high. Color: black areas on white background, commonly with tan, particularly on sides of head. Usually highly nervous.

Bred in Europe and America originally for purpose of going into a fox hole and pulling fox out. This requires a small dog with excellent fighting ability and considerable perseverance. Eyesight and nose of the fox terrier are not exceptionally good but he is full of pep.

In addition to being superior for getting in on "kills" and going where larger animals cannot, fox terriers make ideal house dogs. They are loyal to their masters, sensitive to strangers, noisy in their protest against invaders. This book is written in memory of a boy who loved the fox terrier "Wow" (illustrated) more than all other pets combined.

Boston Terrier
Canis familiaris

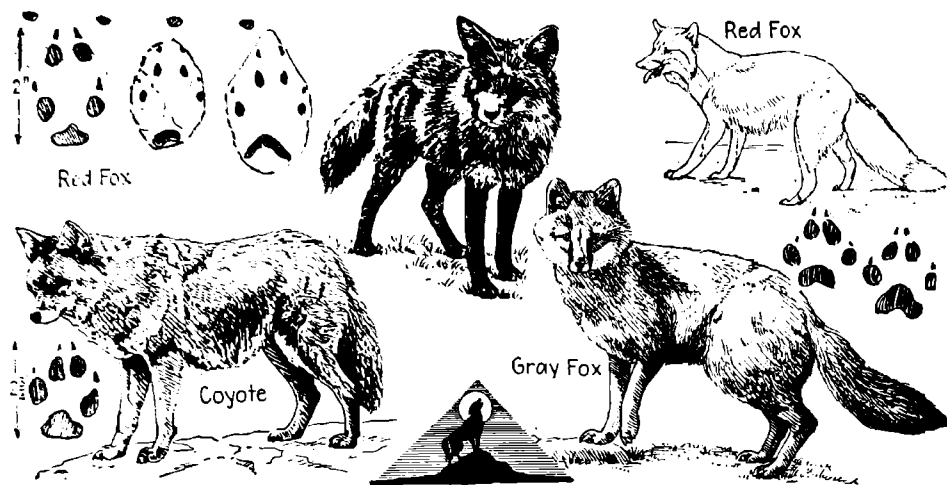
Weight 15-25 lb., with 3 classes based on weight recognized in judging ring. Middleweights, 17-22 lb. Color dark brindle to black, with white on muzzle around neck, on chest and all or part of forelegs and on hindlegs below the hocks. Hair: short, smooth, stiff, shining, and of medium fineness. Ears commonly trimmed. Tail "screwed" or docked but always carried low.

Originated in Boston about 1870 where it was developed from a cross between bulldog and bull terrier. Related French bulldogs are little bulldogs with widespread ears. They lack pep and slenderness of Boston terrier, which probably comes from terrier blood. Legs of Boston terrier are straighter and more slender and white areas larger than in French bulldog.

Boston terriers are most affectionate animals and possibly the most distinctly American breed. Their intelligence and loyalty make them popular as house dogs, particularly where quarters are limited and where furniture must be kept free from dog hairs. Their cleanliness and relative freedom from odor also make them useful as pets.

From puppyhood on, dogs are subject to many diseases. From 8-10 weeks of age they are likely to have attacks of distemper which may be fatal. Dogs so attacked have a high fever, stop eating, vomit, and have scours but once recovered are immune. Distemper can be prevented by serums. Rabies, most dreaded dog disease, may make a dog a community menace and should be controlled constantly. It may be prevented to a limited degree by serums. Tapeworms are destroyed by 1 gr. of freshly powdered areca nut per pound of dog after withholding food for 18-24 hours. Mange is treated by washing with green soap and hot water, then applying sulfur ointment for 3 days. Hookworm, common in South, is treated with 2 drops per pound weight of dog (1 for puppies) of carbon tetrachloride in strong gelatin capsules. Roundworms are treated by giving 2-4 tsp. of mixture of $\frac{1}{2}$ oz. each of spigelia, senna, and licorice sirup, every morning for 3 days.

Dogs suffer from lack of exercise and faulty diet. It is obviously unkind and injurious to confine a naturally active dog for a lifetime in a small apartment and to feed it all the rich food it will eat. Pampering, overcrowding, and lack of exercise invite disease. One simple meal a day preferably at evening is best, taking care that clandestine visits to garbage dumps are avoided as much as possible. Prepared dog foods are not expensive in long run, particularly for house dogs, but even they should be used sparingly.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Canidae. DOGS

Coyote
Canis latrans

Length, snout to tail tip about 4 ft., $\frac{1}{2}$ being tail. Average weight, male 26 lb., female 22 lb. Ears conspicuously large and erect, providing excellent field character. Color pale brown sprinkled with gray, black, or sometimes white, with under parts nearly white and ears darker. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$,

M $\frac{2}{3}$. Tracks: F $3 \times 3\frac{1}{2}$, 4; H $3 \times 3\frac{1}{2}$, 4.

Found essentially in open country from northern British Columbia and middle Alaska east to north of Lake Michigan, through southern Mackenzie and south to Central America. Established elsewhere by escaping from captivity in New York, Florida, and other places. Range now larger than originally. Individual range, 6 sq. mi.

Probably pairs for life. Breeds in January. 3-10 young born 63 days later, blind but furred; nurse 2 weeks; may be taken from den at 3 weeks; at 6 weeks, may venture out on own; run with parents by July. Family together, at least until early fall. Breeds first winter. Life span, if lucky, about 13 years.

Food: 8,263 stomachs show 33% rabbits, 25% carrion, 18% rodents, 13% sheep and goats. Stomachs of 161 "peg-leg" coyotes show 21% rabbits, 21% sheep and goats, 35% carrion, 12% rodents. Full meal equals 2 ground squirrels, totaling 13 $\frac{1}{2}$ lb. Winter diet of 2,589 cases was 36% carrion, 34% rabbits, 15% rodents, 8% sheep, 3% deer.

Important check on grass-destroying rabbits and rodents. General poison campaigns are scarcely justified. Can run 45 m.p.h., hunts in relays, rarely in packs, therefore about only mammal which can catch destructive jack rabbits. Of course may kill deserted newborn calves, horses, sheep, and kids. Fur has good sale value in season.

Red Fox
Vulpes fulva

Length to 41 in., including 16-in. tail. Weight to 14 lb. Male larger than female. Tail bushy. Ears large and pointed. Nose pointed. Sexes colored alike, a golden brown or reddish above and white beneath; with white tail tip and black legs. In young, black on muzzle and back of ears. Color phase black. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{2}{3}$.

Found in wooded and farm lands particularly where there is mixed cover through all wooded Alaska and Canada and south throughout United States except for a Pacific Coast strip, southern Gulf States, and parts of Southwest. Apparently most abundant in country where quail, grouse, and rabbits also abundant.

Strictly monogamous. Mates in February-March. 4-10 young, born 51 days later; blind 8-9 days, in den 3-5 weeks, then may come out to play but retreat to safety until about 3 months old; independent at 5 months; full grown at 18 months. Male feeds female and young and leads enemies away from den at risk of life. Den clean. Life span 12 years.

Food: probably world's greatest destroyer of mice. Eats carrion, fruit, vegetables, game, and poultry, but most of all such vermin as mice. Has remarkable sense of smell, good sight, and excellent hearing, intelligence, and endurance. Active year round, day or night, but mostly at night. Does not climb trees. Tracks: F $1\frac{1}{4} \times 2$, 4; H $1\frac{1}{4} \times 2$, 4; St 18.

Extraordinary mouse destroyer and sporting animal. Pelts bring up to \$20; in silver form, a pair of breeders has sold for \$35,000. Live "silvers" on Canadian farms in 1925 were worth \$2,755,000. One farm has sold over 18 million dollars worth of pelts and employs over 400 persons permanently. Durability of pelt 40% that of otter. Best friend of livestock farmer, orchardist, and grain farmer, but not of poultry men.

Gray Fox
Urocyon cinereoargenteus

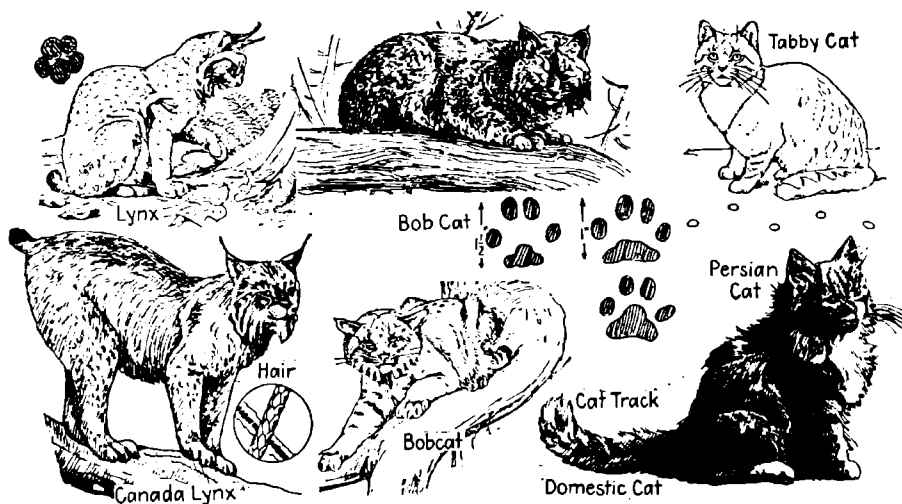
Length to 40 in., including 12-in. tail. Weight to 12 lb. Sexes about equal in size and in coloration. "Pepper and salt," black and gray above with reddish-brown along sides, and gray and tawny beneath. Tail black-marked. Fur shorter and generally inferior to that of red fox, and animal lacks its rank odor. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{2}{3}$.

Commonest in wooded and farm areas principally from New Hampshire and New York to Minnesota; south to central Texas, thence north to Colorado and Utah, south to southern California, north along coast to Oregon. Individual range over 1-2 sq. mi. Range is being extended; numbers possibly increasing.

Ideal family life. Mates in January. Young born 50-60 days later, in clean den in hollow log, cave, or runnel; blind and helpless at birth; take solid food at 6 weeks of age. Family breaks up in August-September, though parents stay together through year.

Food: almost anything, a full meal equaling $\frac{1}{2}$ lb. of rabbit. Stomach survey show 35% of food rabbits, 16% mice, 15% vegetable, 6% pheasants, 5% poultry. Some of animal matter is carrion. Does not store food as does the red fox, lacks its endurance, is more nocturnal and less intelligent. Tracks: F $1\frac{1}{2} \times 2$, 4; H $1\frac{1}{4} \times 1\frac{3}{4}$, 4; St 16.

Probably an enemy of game, but this is offset considerably by destruction of mice. Certainly no worse than cats or some dogs as enemy of wildlife. When pursued by dogs, takes to trees, unlike red fox. Durability of fur 40% that of otter. Value of pelt rarely exceeds \$4; normally $\frac{1}{2}$ that of red fox.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Felidae. CATS

Canada Lynx, Loup-cervier
Lynx canadensis

Length 3 ft., tail 4 in. Height $1\frac{1}{2}$ ft. Weight to 40 lb. Color gray with brown mottlings; usually lighter colored than bobcat. Feet exceptionally large. Tail conspicuously short, black-tipped. Fur long and loose. Skull broad. Ears remarkably tufted in older animals. Calls like the bobcat, a meow, a caterwaul, and a screech.

Generally found in or near thick woods, usually away from habitation. More northern than bobcat. Ranges from New York and northern Michigan, north to Hudson Bay and Alaska, south in Rockies to Colorado and in Sierras to Oregon. Considerably restricted in range in eastern and southern portions.

1-4 young born in spring, 2-3 months after breeding; blind 10 days, suckled 2-3 months. Breed first winter. Father assists in bringing food to and caring for young, so there is true mating. Young stay with mother for nearly 1 year. Clean in habits, particularly in den, which may be in a hollow tree or windfall. Life span 12 years.

Food much same as for bobcat, with emphasis on rabbits and their kind. Number varies greatly with food supply. Pair may have territory 50 miles across. Animal migrates with seasons and with food supply. Does not hibernate. May store food. Tracks: F 3×3 , 4; H 3×3 , 4; St 18.

Probably useful as rabbit and rodent destroyer. Pelt has some value and makes a beautiful robe, soft, light, and warm. Inoffensive to man unless cornered or unless young and old become separated. Can fight dogs most effectively. Fur durability, 25% that of otter.

Bobcat, Wildcat
Lynx rufus

Length 38 in., tail 6 in. Height 15 in. Weight to 40 lb. Reddish-brown, black-spotted, being lighter beneath. More slender than Canada lynx, with short hair, legs, feet, and tail. Ears not tufted conspicuously. Skull narrow. May appear longer but is lighter than lynx. Teeth: I $\frac{3}{3}$, C $\frac{1}{1}$, P $\frac{3}{2}$, M $\frac{1}{1}$. Tracks: F $1\frac{1}{4} \times 2$, 4; H $1\frac{1}{4} \times 1\frac{1}{2}$, 4; St 14.

Found in wooded or brushy land, near to or remote from settlements, from Nova Scotia to Gulf of Mexico, west through Mississippi Valley, with closely related species in abundance in East; in Pennsylvania nearly extirpated with help of high bounty, now removed.

1-4 young born about 50 days after breeding takes place; blind 9 days, suckled about 2 months, reared by both parents, which mate for season at least. Young tames relatively easily but becomes dangerous as it gets older; weighs 8-12 lb. first fall. Den in cave or hollow tree, clean at all times.

Food: of 186 stomachs examined, 126 had rodents, 65 game, 11 stock (carrion), 9 birds. Another study shows food to be 44.5% harmful mammals, 20.5% useful mammals, 19.6% vegetables and soil, 7% parasites, 3% birds. Probably worst enemy of snowshoe rabbits and cottontails and number varies with these species.

Serves essentially as useful check on rabbits and such animals as are destructive to man's cultivated and wild plants. A full meal for a bobcat equals $\frac{3}{4}$ lb. of rats. Certainly no reason why species would be completely destroyed, unless some other equally effective check on prey is available.

Domestic Cat
Felis domesticus

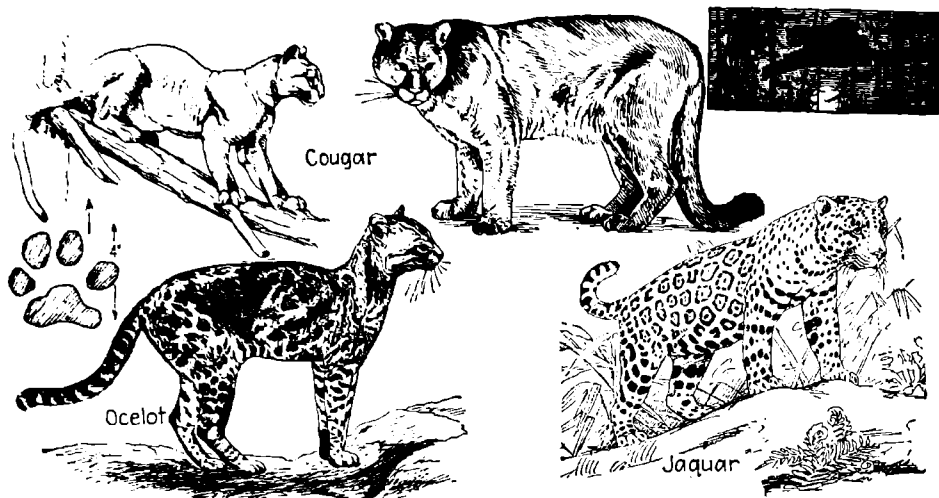
Length about $2\frac{1}{2}$ ft., $\frac{1}{8}$ being tail. Footprints almost round, showing no toenail marks; hind feet step in tracks of larger forefeet, alternating in zigzag to straight line, about 9 in. apart. Tracks: F $1\frac{1}{4} \times 1$, 4; H 1×1 , 4; St 6. Fur varies with breed. Pupil of eye of Persian cat circular; of others a vertical slit.

Developed in Eocene from *Miacis*, extinct sabre-toothed tigers separating in Oligocene. European tabbies or tortoise shell (usually female) a cross of European wildcat and Egyptian cats; Manx, tailless, from Oriental cat; Siamese, beige to seal brown, with black face and feet, blue eyes, from African jungle cat; Persian, long-haired, Asiatic.

3-12 kittens born blind, helpless, 62 days after breeding; 2-3 oz.; cared for by mother. Iris of adult usually yellow, of kittens blue or green. Male gives no care to young; either sex promiscuous at breeding time. Female in heat 1-3 weeks. Male usually larger than female in all breeds. Pulse, 120-140. Respiration, 24. Temperature, 101.7°F. Life span to 10 years.

Probably cats gone wild are among worst destroyers of game. Favor fish as food but eat birds and mammals readily. Individuals known to have killed 4 rabbits a day, 100 chickens a season, and 40 turkeys in a few days. Catch prey by surprise and sudden dash and piercing with long slender teeth. Can see with little light. Smell poorly.

Known to be a disease carrier, 43 hydrophobia cases in New York City alone traced to cats. Probably worst enemy of bird life and should be confined, particularly during bird nesting season. Cannot be trusted. Probably loved, hated, or tolerated by most persons but not economically valuable. Fur in trade, known as "genet."



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Felidae. CATS

Cougar, Puma, Painter, Mountain Lion
Felis concolor

Length to 9 ft., tail 3 ft. Weight to 200 lb. Uniformly yellow-brown but darker above and lighter beneath. Like a large slender small-headed cat. Fur relatively short, close, and uniform. Whiskers rather prominent. Toes retractile. Teeth: $I \frac{3}{1}$, $C \frac{1}{1}$, $P \frac{3}{2}$, $M \frac{1}{1}$.

Tracks: F 4×4 , 4; H 4×4 , 4; St 18.

Found in forested areas, for most part, but also in rocky canyons and even desert lands. Ranges from coast to coast, between Quebec and Vancouver Island, south to Patagonia including a number of varieties. Eastern variety once ranged from southern Canada to Gulf of Mexico but is now greatly restricted.

Pairs. Both parents care for 1-5 young, which are born any time of year, 91 days after breeding; blind, 8-9 days, first teeth 18 days, crawl at 7 weeks, suck meat at 9 weeks, eat meat at 3 months, weaned at 3-4 months. Black-spotted over yellow, for first 2-18 months. With mother 1-2 years. Live to 20 years.

Food, meat, a full meal equaling 7-8 lb. of deer meat. Can drag 900-lb. moose 300 ft. on snow. Of 43 stomachs examined, 34 had deer, 2 corn, 1 each skunk, cat, hog, and calf. Can jump up 15 ft. or down 60 ft. in safety and often ranges 20 miles a night over a 60-mile territory claimed by individual. Bites neck of prey.

Troublesome destroyer of domestic animals and game where abundant but a valuable check on plant eaters where other checks do not exist. Known in rarest of cases to attack man. Favors horses and deer much as black bears favor pigs; coyotes, sheep; and wolves, cattle. Should not be completely destroyed.

Ocelot
Felis pardalis

Length 3 ft., with 15-in. tail. Weight 35 lb. Grayish-yellow with large fawn colored, black-bordered spots. Slender, like well-proportioned cat. Ears usually black, with white spot below. Tail usually spotted or ringed. Hair soft and not thick, but individuals vary greatly. Several varieties recognized.

Haunter of woods and thickets, from southwestern United States and Mexico through to South America as far as Paraguay. Allied margay (18 in. long with 8-in. tail) with black lines and bands is found from Mexico to Peru; other relatives include linked ocelot with chain-like markings, and long-tailed ocelot.

Little known of family life but probably breeds in June and bears 2 young (apparently always 2) in September-October. Farther south than United States, breeding and bearing young probably take place at any time of year. Young blind at first. Den usually in a cave in rocks, well-lined with comfortable bedding.

Food about 5 lb. of flesh a day, including reptiles, birds, mammals, and amphibians; in fact, almost any form of animal life it can overpower, even though evidence indicates that cold-blooded animals may cause indigestion and cat flesh an itching. Each animal hunts alone, seizing prey by neck and holding it to ground until death.

Probably useful in controlling smaller plant eaters; unquestionably injurious to poultry and smaller forms of livestock; particularly destructive of pigs, kids, and lambs, but apparently does not attack man though fights powerfully if cornered. Caught young, can be tamed relatively easily; often kept as a pet.

Jaguar, American Leopard
Felis hernandesii

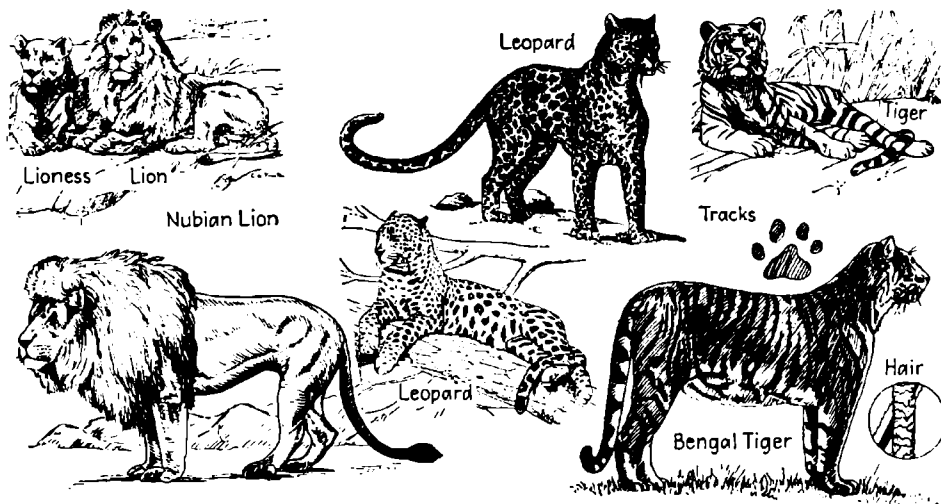
Length, total to 79 in., average male $7\frac{1}{2}$ ft., female $6\frac{1}{2}$ ft. Height 28 in. at shoulder. Weight around 250 lb. Yellow above and white below, with $\frac{1}{2}$ -1 in. spots of black, often of 4-5 around a central spot but varying greatly in different parts of body. Fur relatively short. Tail shorter than in African leopard.

Found from Texas, New Mexico, and Arizona south through Brazil and Paraguay, living in jungles of heavy vegetation for most part. Southern limit is about northern boundary of Patagonia and original northern limit rather wide in North America.

Jaguars pair definitely, breeding in January, with 2-4 cubs being born about 100 days later. Both parents assist in rearing young. By 6 weeks, cubs are as large as domestic cats. At 1 year of age, young can shift for themselves; at 3 years of age, they may mate and breed. May live for 20 years.

Food almost any common animal, since it can kill deer, horses, cattle, sheep, tapirs, monkeys, pigs, fish, and birds. It can pursue prey in dense vegetation, into trees, and even into water. Known on occasion to attack and to eat human beings, and at all times a formidable foe if its freedom or its family's freedom is threatened.

As a destroyer of domestic animals, it has roused the enmity of all who raise cattle and horses for profit. In modern times, it has learned to avoid men with guns but in the wilds, full-grown animals have been known to attack men without provocation. Pelt valuable and of excellent quality.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora. Family Felidae. CATS

African Lion
Felis leo

Length male to 8 ft., plus 3-ft. tail. Height at shoulder 4 ft. Weight to 583 lb. Female usually 1 ft. shorter and more slender than male and lacks conspicuous mane of adult male. Color yellow brown without stripes and only slightly lighter beneath. Mane almost black in older animals, lighter in young.

Found throughout Africa from the Cape to Algeria and Ethiopia; in Asia from Mesopotamia and southern Iran to northwest part of India. Formerly roamed through Syria, Arabia, southeastern Europe, and in prehistoric times through Germany, France, Spain, and British Islands. Now restricted to Africa for most part.

Pairs for life, not promiscuous. 2-4 young born 16 weeks and 1 day after breeding. Young born with eyes open; helpless for several weeks; about size of large cat, with frizzled fur. Young female suffers at teething time and may die; weaned at 3 months. Mane appears at 3 years and is at best at 8 years. May live to 25 years. Nocturnal and diurnal.

Food: flesh, fresh or carrion. Attacks almost invariably from ambush, striking at flank or throat below jaw of buffaloes, zebras, antelopes, or giraffes in Africa. Can leap 12-ft. fence or more than 40 ft. or dash 100 yd. at 60 m.p.h. Pulse, 40-50. Respiration, 10.

Serves role of natural check on plant eaters. Prized game animal. Old individuals may become man-killers. Normally will not annoy men unless in danger; then fights powerfully with teeth and claws. Appears in earliest recorded history, in the Bible, and figured prominently in early Roman sports. Can be trained to perform well.

Leopard
Felis pardus

Length, male, body 57 in., tail 38 in. Weight 200 lb. Female may average smaller, some as short as 5 ft. total. Tawny yellow above and whitish below, with numerous rosettes of dark or black circular spots resembling animal's foot-print over body, these being smaller on head. Tail sometimes ringed. Fur durability, 75% that of otter.

Found in Africa, from the Cape to Algeria; in Asia, from India, Burma, Thailand, Ceylon, and Malay Islands west to Syria. Formerly, through Europe to Spain, and Great Britain. Black leopards or "panthers" with deeper ground color are found only in Asia. African leopards have smaller, more solid spots.

Thought once to be a hybrid between a male panther and lioness, but this is not so. 2-4 young usually born in spring, 3 months after breeding time. Family may stay together until young are full-grown; adults may live 28 years. Hunt sometimes in pairs but more often singly.

Food captured by long leaps, often by pursuit, seizing prey by throat, breaking spine or strangling it, sometimes tearing front with powerful claws. Eats antelope, monkeys, deer, calves, sheep, goats, pigs, and donkeys, and favors dogs, the latter sometimes being caught in broad daylight, though most hunting is done at night. Can swim. Can leap 10 ft. up.

One of most wary and most treacherous of beasts; powerful fighter when wounded. Less suspicious of traps than tiger and so more commonly trapped with goat or dog as bait. Can climb trees easily, where lions and tigers do not, so must be hunted differently; it can run up a smooth trunk as easily as a monkey and turn on its attacker.

Bengal Tiger
Felis tigris

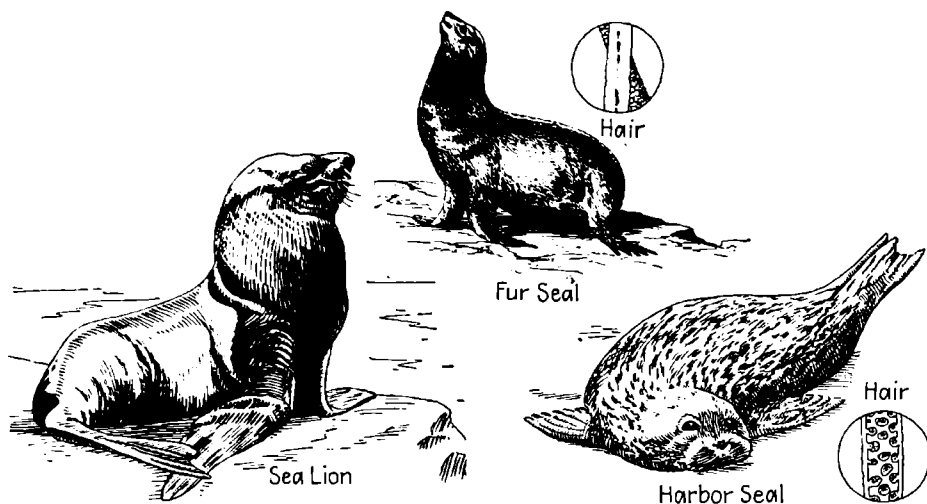
Length 6½ ft. plus 3-ft. tail, or to 11 ft. Weight 500 lb. or more. Female slightly smaller, with lighter and narrower head. Old male has long hair on cheeks but no mane. Hair relatively short and smooth. Fawn-colored or reddish, with white under parts, and with many black transverse stripes. Highly variable.

Essentially of jungles, found only in Asia and particularly in India and from northern China to Malay Peninsula. Unknown in Ceylon, Philippines, and Malay Archipelago but common in Java and Sumatra. Animals of warmer climate larger, more brilliantly colored, and more powerful than those of cold climates.

Adults pair; breed in alternate years. 2-4 young born 15 weeks and 4 days after breeding, usually 2, 1 of each sex. At 6 weeks, young follows mother; at 7 months, young can kill independently; family may run together 2 years. Cubs become mature at about 3 years, when family breaks up. Captive animals may live 25 years. Respiration, 6.

Food, flesh, with individuals favoring different kinds. Some animals favor game such as deer or wild pigs; others favor cattle, horses, sheep, or pigs; and a few favor man, the man-eaters usually but not always being females. Prey is seized in a rush or spring of about 15 ft. or less, grasping forequarters with claws and biting throat.

Known to have killed as many as 60,000 cattle, sheep, and goats in India in 1 year and as many as 4,000 human beings in 6 years; 1 animal credited with 80 men in 1 year. Male usually roars when hit with bullet but female does not. Prized animals for big-game hunters but feared greatly by natives. Hunted sometimes on elephants.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Carnivora

Family Otariidae

Steller Sea Lion

Eumetopias jubata

Length to 10 ft., female smaller. Weight of male averages 1,500-2,000 lb. Shoulders heavy. Ears small, not more than holes. Appears sleek, wet, and shining, even when dry. Black, dark-gray, or yellowish- to dark-brown. California sea lion, *Zalophus californicus*, much smaller; about 600 lb., but to 1,000. Teeth: I $\frac{3}{2}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{1}{1}$.

Found along Pacific Coast from Bering Sea south to Farallon Islands in California; most commonly seen by tourists on rocks off California coasts, where their presence is well advertised. Bask on rocks or dive rather awkwardly into sea but swim beautifully. About 2,500 believed on rocks off San Francisco. Unlike seals, can bend hind flippers under and forward.

One bull has many cows in his harem. Breeds in Bering Sea in July and at San Francisco in summer, breeding taking place just after birth of pup, which is born singly 12 months after breeding. Pups learn in 1 week to swim and care for selves, maturing and breeding when about 3 years old.

Food, fish of many kinds, crustaceans, squid, and other marine animals. Animals in water not disturbed by approach of men but take flight when they approach on land. These sea lions outnumber all their kin from California to British Columbia. Most circus "seals" are California sea-lion cubs.

Not demonstrated as harmful to commercial fish. Some value as pet, as circus animal, as curiosity, and as source of oil and leather. Fur valueless as compared with fur seal. Bulls killed for stiff whiskers, excellent for cleaning opium pipes; for gall bladders used in medicine; and for genitals that are dried, ground, and used as aphrodisiac and rejuvenator.

Alaska Fur Seal

Callorhinus alascanus

Length to 75 in., female 50 in. Weight male 600 lb., female 50-100 lb. Upper parts black, gray over neck and shoulders, flippers red-brown. Female gray above, brownish beneath. Beautiful sleek animal, with essence of grace in movements. External ears mere holes.

Teeth: I $\frac{3}{2}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{1}{1}$

Found in Bering Sea and Pribilof Islands in summer, and female, south to California in winter, breeding in northern part of range. Winter migration lasts 7-8 months, bearing west then turning east to California, then north to starting point. Fur durability, 80%.

Adult male bull over 6 years old reaches breeding ground first and selects territory. Young male *bachelor* follows and attempts to hold space. Female *cow* follows, gives birth when to 3 years old to young *pup* on rookeries, is accepted into harem and breeds immediately. Bears 1 young each year thereafter. Males fight severely.

Food almost solely fish and squid. Enemies, killer whales and man. Temperature of body, 101°F. If the temperature reaches 103°F., they pant vigorously. Fur of commerce is covered with long hard guard hairs which are plucked to bring out beauty of underfur. One bull may have 100 cows in harem. Rest season, July.

Valuable fur bearer, the harvest for some years prior to development of Second World War being controlled by international agreement, which Japan in 1940 refused to continue to observe. Most destructive practice consists in killing nursing mothers at sea rather than superfluous males. Breeding males eat nothing May-August.

Family Phocidae

Harbor Seal

Phoca vitulina

Length to 60 in. Sexes equal in size. Color variable from yellow-gray to gray, with dark-brown or blackish spots. Young animals white. Limbs relatively short for a seal. Hair exceptionally coarse. At least 4 species or subspecies recognized over a wide area. Pacific species, *P. richardii*. Teeth:

I $\frac{3}{2}$, C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{1}{1}$

Found in harbors, along shores, and at mouths of rivers and bays. Atlantic species ranges from Carolinas north, and Pacific species from California north to Alaska and Pribilof Islands. Easily recognized by spotted coat and relatively small size.

Young born in early spring, when animals are found together in small herds but never congregating on large rookeries as do the fur seals. General reproductive habits probably similar to others of family. Fur durability, 25%.

Food essentially fish, squids, crustaceans, and other forms of marine life. Examination of 81 stomachs by one investigator showed 95% of food fish, remainder invertebrates. Another investigator found food half fish and half invertebrates in 35 stomachs. Probably a rather general feeder.

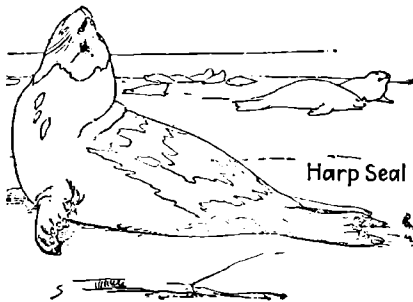
Of little value for fur, hide, or oil and can hardly be sought commercially because individuals are not congregated into large herds where many may be killed at one landing. Some relatives such as harp seal are hunted for their oil in great numbers off Gulf of St. Lawrence.



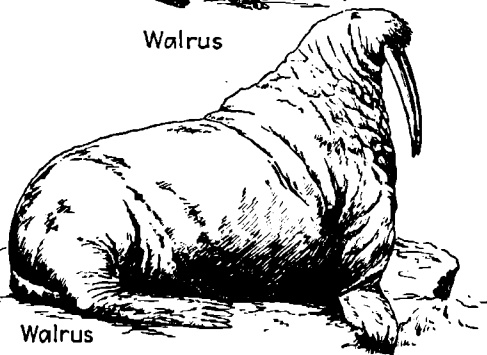
Hair Seal



Walrus



Harp Seal



Walrus

PHYLUM CHORDATA. CLASS MAMMALIA
Order Carnivora

Family Phocidae

Family Odobenidae

Hooded Seal (Not illustrated)
Cystophora cristata

Length to 96 in., or rarely 9 ft. Weight of male 1,000 lb., of female to 900 lb. Blue-black on back with lighter belly and varied with lighter spots. Male has muscular sac from center of head to nose which can be inflated. Unlike many other seals, has 4, not 6, incisors on upper jaw in front and 2, not 4, on lower jaw.

One of most abundant North Atlantic seals, ranging north of New England to Newfoundland and Greenland. Only exceeded in size in Atlantic by bearded seal. May herd off Newfoundland and Labrador coasts where fishing is good; in summer, off southeast Greenland; February-March, off Labrador on ice floes.

Single young born February-March, shapeless, furry, steel-gray, increasing 3-4 lb. each of first 8 days after birth and reaching full size at 4 years when it becomes mature and breeds. Young nursed by mother for 2 weeks, then gets own food. Yearling seals known as "bedlamers." Female an excellent mother.

Food largely fish, good-sized fish often being swallowed whole. Both parents will defend young and themselves vigorously. May travel rapidly over ice and when kept from water by ice may suffer greatly from skin burning. This species more quarrelsome than most seals with which it is found.

Hide tanned to make leather; flesh, or blubber, used for oil. One ship in 1911 destroyed 49,129. Animals pursued until they take to ice floes, there exhausted and are easily killed. Industry has been ruined by unwise harvesting practices. Seals are great destroyers of valuable fishes. In 80 years, catch dropped from 600,000 to 220,000.

Harp Seal
Phoca groenlandica

Length to 5 ft. Rather slender for a seal. First toe of forefoot not longer than second. Male white or yellowish-white with blackish face and curved blackish band that extends down each side and meets over shoulders and over tail. Female and young with less definite pattern, usually mottled. Teeth: I $\frac{3}{2}$,

C $\frac{1}{1}$, P $\frac{4}{4}$, M $\frac{1}{1}$.

Found in Arctic seas of both Atlantic and Pacific oceans and originally described from Greenland and Newfoundland area. Related ringed seal *Phoca hispida* is smaller and ranges somewhat farther south, being originally described from Labrador area. Harbor seal *Phoca vitulina* (4 ft. long) ranges still farther south.

Young born in spring when animals are found together in small herds but not congregating in enormous herds on established rookeries as do fur seals. At birth, young harbor seals are covered with a thick white woolly down. Young ringed seals may be born in an excavation in a bank of snow, remaining there several weeks.

Food essentially fish, squids, crustaceans, and other forms of marine life. Probably a general feeder, since about half food is vertebrate animals and other half invertebrates. Animal is gentle and affectionate and, unfortunately, unsuspicious.

Harp seals are easily killed in large numbers at breeding time and yield great quantities of oil and leather for commercial use. Not valuable as fur bearers as are fur seals. Some think that seals are destructive of fish and fish foods but leather and oil they yield amply compensate for any loss through food habits.

Walrus
Odobenus rosmarus

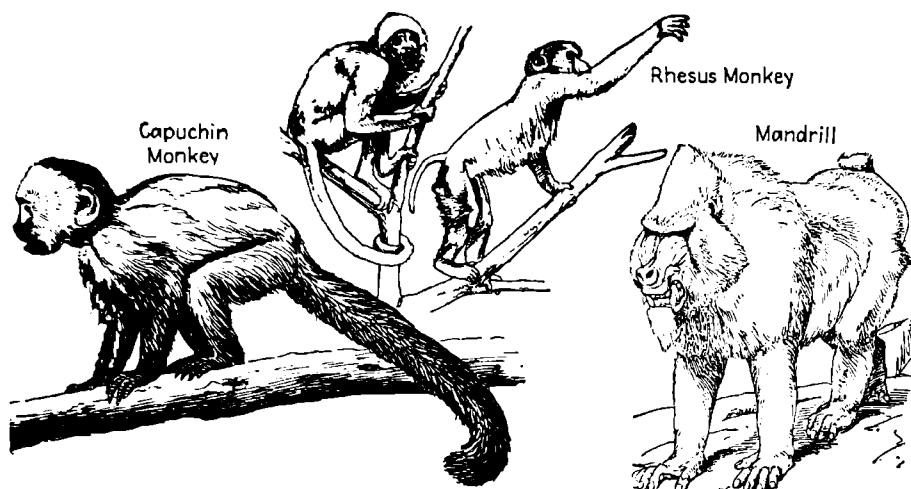
Length, male 10-12 ft. Weight to 3,000 lb. Female about $\frac{3}{4}$ size of male. Almost hairless, with wrinkled skin. Head relatively small. Nose blunt, with coarse bristles. Practically tailless. Flat nails on 5 toes on front flippers. 2 flat and 3 pointed nails on hind flippers. Teeth: I $\frac{1}{0}$, C $\frac{1}{1}$, P $\frac{3}{3}$, M $\frac{0}{4}$.

Found in Arctic seas; in Atlantic south to Labrador. Pacific walrus found from Bering Sea to south of Pribilof Islands, and more numerous on Siberian than on American side. Northern migration, May-July in both species.

Breeds on northern migration, young born 11-12 months later. Mid-July embryo, 5 in. long. Young of late July, size of harbor seal; by August, 4 ft. long and 120 lb.; hangs to neck of mother with flippers and protected by her. Tusks, of male straight, 14-39 in. long, 6-9 lb.; of female slender and bowed.

Food largely mollusks grubbed from bottom with help of strong tusks. Strongly social animal which is normally timid but becomes excited easily. Has many parasitic lice and is preyed on by killer whales, bear, and, most of all, man.

Commercial value of an Atlantic walrus is about \$50, but worth much more than this to Eskimos who use flesh for food, hide for equipment, intestines for window glass, and oil for light. Atlantic "catch" in 1939 about 1,300. Take regulated by natives so that supply continues indefinitely, particularly in Siberia.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Primates

Family Cebidae

Capuchin Monkey (New World) *Cebus capucinus*

New World monkeys small, have thumb and big toes opposable, nostrils widely separated, toes and fingers with nails, and tail prehensile. Besides the sapajous, which include the common hand-organ monkey, there are howlers, spider monkeys, squirrel monkeys, sakis, and other groups of species, all with prehensile tails. Sapajous have a cowl-like growth of hair on forehead.

Sapajous include the weeper of Brazil, brown with yellow tinge and paler throat, cheeks, and chest; white-cheeked of Brazil, with blackish fur and yellow-white temples; white-fronted, of many parts in South America, with red-brown fur but white on front and chest; and Central American white-throated, black with white throat.

Period from generation to generation is never less than 3 years. General notes given for rhesus monkey probably apply rather well to capuchins. These monkeys roam through forests in troops of up to a dozen animals under leadership of an old male, usually going over definite routes in single file from resting sites to feeding areas.

Food chiefly fruits and tender shoots, but they also enjoy birds' eggs, young animals, and insects. In captivity, they learn to eat much the same food as does man. Some species, particularly the White-fronted, are noisy. Related howlers are well named and sound like much larger animals than they are.

Principal use of these animals to man is to serve as pets though many monkeys, particularly those with longer fur, have been considered as fur bearers; some species have been practically exterminated for their pelts which at times may be considered stylish. They may cause some damage to fruits and other crops.

Family Lasiopygidae

Rhesus Monkey (Old World) *Macacus rhesus*

Old World monkeys, including rhesus, do not have prehensile tails as do New World monkeys. Old World species sit on calloused buttocks which are free of hair, and most have distensible cheek pouches. Rhesus is generally gray-brown, with tail $\frac{1}{2}$ length of body, with bare face which, in adults, is reddish.

Rhesus monkey native of northern India, where it lives in great numbers in trees or on ground, often as parasite on bounty of natives. South American monkeys, Cebidae, are arboreal, with prehensile tails like capuchin monkey. Rhesus monkeys are closely related to tailless Barbary ape of Gibraltar.

1 young rhesus born $5\frac{1}{2}$ months after promiscuous breeding; at birth, 1 lb.; nurses at 1 day and for 1 year, when weighs $3\frac{1}{2}$ lb. and sits 1 ft. high; at 2 years, 4 lb., 14 in.; at 3 years, $6\frac{1}{2}$ lb., 16 $\frac{1}{2}$ in., and female sexually mature; conception, tenth day after menstrual flow. Male matures at 4 years. Respiration, 19.

Food essentially plant materials but this varies and is much like that of man. In fact, dietary problems of man are studied through rhesus monkeys' reactions. Rhesus also susceptible to human diseases; infantile paralysis being studied through them. Considered sacred by natives in India and therefore cannot be harmed there.

Rhesus monkey worth \$8-\$25 as experimental animal for studying disease. Colony of 500 established on 36-acre island off Puerto Rico and special laboratories maintained at Orange Park, Fla., and at Yale University by Rockefeller Foundation, which set aside a fund of \$189,000 to continue work 1939-1944.

Family Cercopithecidae

Mandrill, a Baboon *Papio mormon*

Head proportionately large, with large, long canine teeth. Teeth equal in number to those of man-like apes. Mandrills are brilliantly colored on bare buttocks; middle line of nose is scarlet with deep purple and light blue on either side. Fur blackish-olive, darker above, and beard is orange-yellow.

Largest baboons, found on west coast of Africa. Baboons confined to Africa and southern Arabia. Sacred or dog-faced baboon, found in Ethiopia and Sudan; chacma or pig-faced baboon is from southern Africa; and mandrill, brill, and yellow baboons are from African west coast. Medium-sized chacma has a 2-ft. body.

Most baboons, mandrills included, live in troops of 15-50 animals. Males are largest and rule troop. Females often carry young on their backs, young sprawling and hanging onto long hair or straddling and riding as though they were on horses. Whole troop joins in protection of weaker members.

Food largely roots, fruits, tender shoots, and any of smaller animals such as birds, mammals, lizards, and insects which they can capture. In captivity, they will eat almost anything. Better suited to life on ground than in trees. Practically all baboons are mean, ugly, powerful, disgusting, and cunning animals.

Highly destructive to crops. Able to drive unarmed humans from an area when sufficiently abundant. Some can catch and hold dogs in their hands until they can get in an effective bite. Some are considered sacred; some have been trained to collect fruits; but all are generally unreliable neighbors and better dispensed with in most places.

PHYLUM CHORDATA. CLASS MAMMALIA

Order Primates. Family Hominidae

Homo sapiens. MAN

Man in the History of the Earth

Back in Eocene times, between 55 and 60 million years ago, there lived a little rat-like animal, not unlike the feather-tail, *Plilocercus*, now found in Far East jungles. From it sprang a race of animals which developed into monkeys. Also from this line developed a race which included the present-day gibbons, orangutans, man, gorillas, and chimpanzees. The gibbons separated from this stock in the Oligocene, some 40 million years ago. The orangutans became independent early in the Miocene, or some 30 million years ago. About 25 million years ago, man declared his independence from gorilla and chimpanzee and set about making the world over to suit his wishes.

The story of that 25 million years can hardly be told in $\frac{1}{4}$ of a page. While man is, to us, the most interesting of all living things, he is not all of natural history and could not live a single day without his associated plants and animals.

Some 6 or 7 million years ago, man's ancestors were represented by a stock of which the Java man (*Pithecanthropus erectus*) and the recently discovered Peking man are examples. From this line branched the Heidelberg man and the Neanderthal man, both of whom vanished in history without leaving present-day descendants. From the remaining common stock sprang the Piltown man, who left no living descendants. Also from this stock was derived a man now represented by the Australian blackfellows, the most primitive of existing human races. Somewhat later, there came from the remaining common tree, the ancestors of our current Hottentots, followed still later by the ancestors of the present yellow race. The white American of today is for the most part a descendant of the Cro-Magnon man who lived in the Pleistocene and evolved out of existence except in modified descendants.

It seems ridiculous to assume that any race of modern men incorporates all the worthy qualities of human beings. When one looks at the white race's record of wars and destruction, it is even more absurd that its members should consider themselves supermen. However, we in America, black, white, red, yellow, and mingled, cannot but feel pride in our record of peaceful pursuits, in the help we have given others even though we have plenty of faults of which we should be genuinely ashamed. We like to feel that the future of man lies along the paths we have opened.

Man, the Builder

Man should be happy. Through his own efforts, he has solved many problems involving labor, ignorance, boredom, health, security, and faith.

Through invention, machines have been constructed which take from the backs of men and of dumb animals much of the work which made existence a living death for many who went before us. One generation, one nation, and one man has been able to learn through the experience of former generations, nations, and men.

Through education, the benefits from the experiences of others have been spread widely. No longer is knowledge of how to live and the opportunity to live happily limited to a few. In the ideal democratic government, every man has the opportunity to make the most of the gifts granted him by heredity, chance, and effort.

Through planned recreational activities, men have been released from boredom and from the mischief-making that so often in the past led to trouble for others on the part of those who could afford leisure. We have, on occasion, produced remarkable art. Some of our music makes life worth living. Our theater, our literary leaders, our public park systems, at their best, all suggest progress and all invite effort for improvement.

Our health agencies have conquered many diseases that caused unnecessary misery in the past and are daily solving new problems. Here and there we lose a fight against the forces of disease, but usually these setbacks help us later to win another battle. We are making progress. Tuberculosis, diphtheria, yellow fever, malaria, and many other diseases, such as those associated with childbirth, are not the specters they were a generation ago.

We are making some progress but perhaps also losing some ground in the field of security of the individual for the future. With all the opportunities we have for providing for our physical and mental needs, there should be no poverty for any worthy member of society.

Best of all, we have faith that with free speech, a free church, free schools, a free press, and freedom of opportunity a system will develop in which selfishness and greed will find no opportunity of expression, *if responsibility is recognized as being of equal importance with freedom.*

Man, the Destroyer

Soil and Minerals. For eons before man came into being on the earth, a rich soil had been built up in the territory where he now lives. Much of this valuable topsoil has vanished downstream in China, and America, or under sand in Africa, in part because of short-sighted agricultural practices. Fresh waters have been defiled. We are exhausting prodigally such nonrenewable resources as oil, coal, and the ores. For this, we shall be held responsible in the future.

Plants. In America, we have foolishly stripped from the land our forests and the soil-anchoring grasses. We have the Dust Bowl today. What shall we have tomorrow?

Animals. We have enslaved helpless domestic animals. We trap thousands of useful fur bearers by the most inhumane methods. We have led to the extinction or near-extinction of many useful species of birds, fish, and mammals such as passenger pigeons, salmon, whales, elk, bison, and sea otters. We are steadily reducing the numbers of most of our forms of native game.

Fellow Men. We have enslaved weaker races and weaker individuals of our own race and of our own families. We have kept people in ignorance of how they can avoid disease, of how they can live within their incomes. In part as a result of these practices, we find a world of recurring, increasingly destructive wars. For this, our generation will be considered as lacking in intelligence by our successors. We shall justly deserve this condemnation.

Man, the Animal

Fruitful mating may take place at any time of year. With males, this may begin at 10 years, more commonly about 16 and extend until old age. With females, menstruation begins between 10 and 18 years and conception may result from mating at any time until it ceases usually in late forties. Young are born 9 months after conception. Apparently, the happiest life centers around a family of the monogamous type where neither parent has a history of sexual behavior for which either could have regrets. Body temperature, about 98.8°F. Pulse 60-80. Respiration, 15-20. Hearing range, 12,000-17,000; voice, 40-1,152 c.p.s. Needs to 25 gal. of water daily. Speed, to 25 m.p.h.

Man



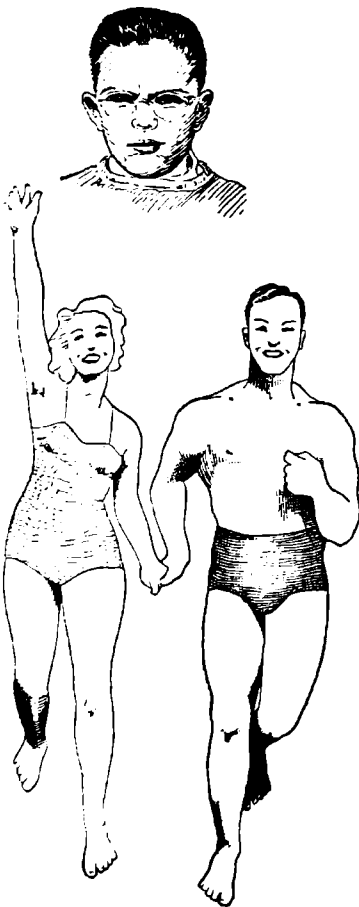
Java Man



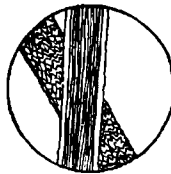
Neanderthal Man



Cro-Magnon Man



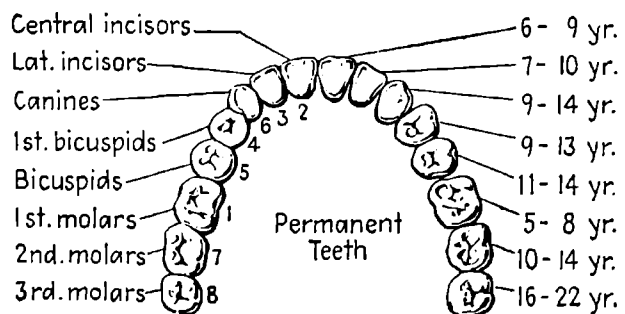
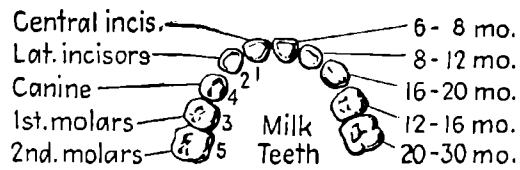
Modern Man

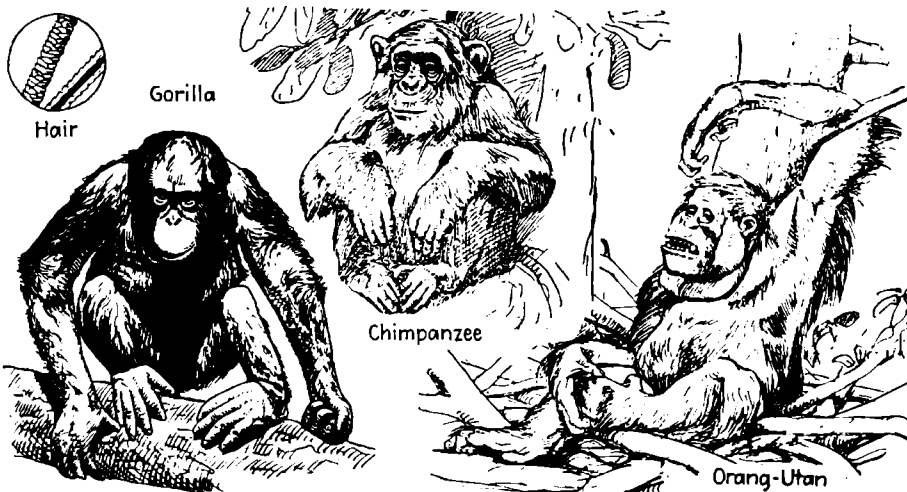


Hair



Piltdown Man





PHYLUM CHORDATA. CLASS MAMMALIA
Order Primates. Family Simiidae. APES

Gorilla
Gorilla savagei

Male stands erect, measures nearly 6 ft. and weighs 300-600 lb. Female much smaller. Hair gray, 2 in. long on arms, 1 in. on belly, shorter and blacker on back; in old male absent on chest and upper back. Face, hands, and feet black. Ears small. Mouth large, with thin lips. Chin short and receding.

Found in wooded Africa, though rarely if ever seen in trees. Best known in recent years from the Tanganyika region where it was studied principally by the late Carl Akeley. Formerly probably ranged across Africa in tropical regions, since it was reported from Guinea and elsewhere along Atlantic Coast. 2 species of gorillas recognized, mountain and lowland.

1 young, born 9 months after breeding. In the wild, a male with several females and young may make up a troop. Young walks more erect than do adults. At 4 years, a young gorilla may weigh 140 lb.; at 7 years, it reaches sexual maturity. Life span may be as much as 28 years.

Food, a variety of plants and possibly some animals, but principally bananas, cabbage palms, plantains, and succulent plant materials. Usually walks on all fours, rolling from side to side, shuffling, with head erect and eyes forward. When angered, male may beat chest and roar but in captivity is generally good-natured and intelligent.

Known to man since fifth century B.C. and for most of that time hopelessly misunderstood, probably due to desire of explorers to exploit dangers of their journeys and their own bravery. Described scientifically in 1894. Until recently, young had not been raised in America to maturity. Separated from chimpanzees 10 million years ago.

Chimpanzee
Pan or Simia satyrus

Stands about 5 ft. tall when erect. Weight, males to 170 lb. Body covered with black hair. Walks more erect than other apes but stands with feet more widely spread than man and with knees bent. Arms shorter than in other apes, though they reach below knees by length of fingers. Thumb is smallest finger. Thumb of foot powerful and long.

Forest dweller, confined to western and equatorial Africa. Generally remains on ground in thick underbrush, climbing to treetops easily for escape or in search of food. Often found in troops of considerable numbers and apparently likes association with man when treated with any consideration.

1 young born 9 months after breeding, in nest guarded by male. At 9 days old, weighs 2¼ lb. and is 15½ in. long. Female becomes sexually mature at 5½ years and male probably later. Life span of captive animals, and presumably of those in the wild, is 18-25 years.

Food, largely plants particularly bananas, gingerberries, and corn. Moves from one part of forest to another seeking food, frequently calling loudly and fearsomely night or day. Powerful, particularly with the arms, a zoo animal pulling 1,260 lb. on a dynamometer. Gentle unless opposed, then fierce.

Probably slightly destructive to crops raised by natives and certainly awe-inspiring, but probably minds own business rather thoroughly. Used for studying some fundamentals of behavior in the closely related species, man. Not abundant enough for use as experimental animal in medicine on any large scale.

Orangutan
Pongo pygmaeus

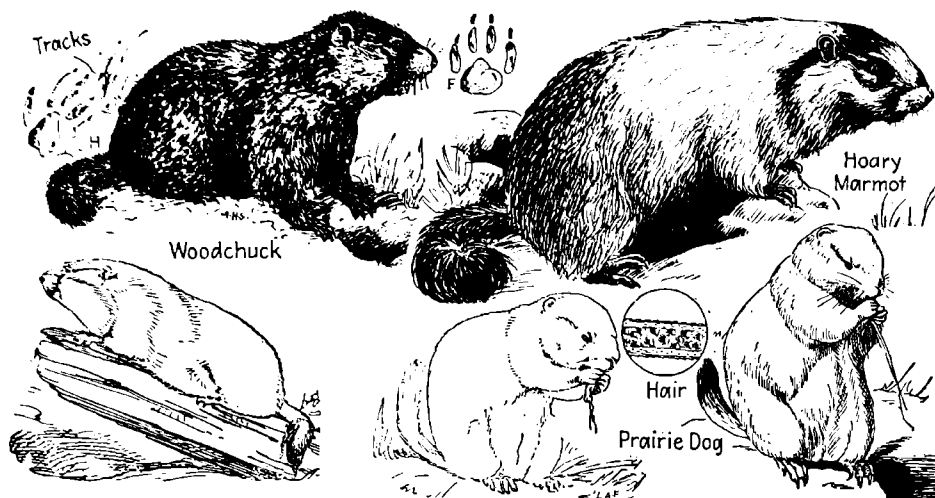
Adult male 4½ ft. high when upright, with fingers nearly reaching ground. To 200 lb. Legs short, thick, with knees turning outward and soles of feet inward. Head pear-shaped, with high forehead, flattened nose, small ears, and projecting mouth with narrow lips. Skin blue-gray, with long shaggy reddish-brown hair.

Native of Borneo and Sumatra, living in trees in low marshy country and rarely coming to ground. Borneo orangutan is of the species *Simia bicolor*. Orangs are popular animals in zoos and lend themselves to conditions of confinement, but have many diseases.

Live in small family parties consisting of parents and 2-4 young. Build a sort of platform or nest in trees where they sleep until late morning, leaving it to feed during middle of day. Are commonly gentle and affectionate but will fight fiercely and ably when forced to do so. 1 young born 8½ months after mating. Life span to 25 years.

Food largely fruits, favoring the durian, the spiny rind of which they remove and discard for the luscious pulp. They also eat nuts and tender shoots and enjoy buds and young stems of bamboo. Captive orangs learn to eat and drink same foods that man favors.

Orang is lower in the animal scale than chimpanzee and gorilla. Trained to eat, behave, and dress like a man, an orang makes a valuable zoo or circus animal and is immensely popular because of its droll appearance and its obvious enjoyment of being appreciated.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Rodentia. Family Scuridae. SQUIRRELS

Woodchuck, Ground Hog *Marmota monax*

Length to 27 in., including 6-in. tail. Female totals 22 in. and is lighter. Fur rather coarse, but might be used for decoration. Grayish-brown, reddish, black, or more rarely white. Sexes colored alike but young paler. Large strong anal gland produces musky odor. Weight 5-12 lb. Teeth: $I \frac{1}{1}, C \frac{0}{0}, P \frac{2}{1}, M \frac{3}{3}$.

Tracks: $F 1\frac{1}{2} \times 1\frac{1}{4}$, $H 1\frac{3}{4} \times 1\frac{1}{4}$, 5; Sp 5.

Found from mouth of Gulf of St. Lawrence, north to Hudson Bay, upper Mackenzie region, and central Alaska; west and south to northwest Montana, eastern Nebraska, on to Louisiana and north to western North Carolina and New England. Essentially in open farming country but also in woods and sometimes up trees, usually where dry.

Mates in early spring immediately after hibernating. 2-8 young born 4 weeks later, blind, naked, helpless and about 4 in. long with $\frac{1}{2}$ -in. tails; crawl at 3 weeks, take solid food at 4 weeks, play at 5 weeks, then cease nursing. Sexually mature at 1 year. Average weight in March, 5 lb. 10 oz.; in September, 10 lb.

Food almost exclusively plants although flesh such as insects, mice, and birds may be eaten occasionally. Has a clean den at end of burrow but above lowest burrow level, with wastes in separate room. Active mostly in day but sometimes during night. Hibernates. Body temperature, 94.8-104°F. Fights most effectively. Whistles when alarmed.

Great destroyer of forage. Burrows are dangerous to horses and cattle but permit water to enter ground and hold soil moisture. Burrows protect rabbits in winter and summer. Woodchucks protected in Pennsylvania because of assistance given rabbits. Flesh edible. Fur durability, 20% that of otter. Ground-hog day, February 2, a delightful hoax.

Hoary Marmot *Marmota caligata*

Length, male to 30½ in., female smaller. Largest of American marmots. Weight to 15 lb. Silvery-white, peppered with black on back and rump. Head and face black with white eye patch. Feet blackish. Under parts dirty white. Teeth: $I \frac{1}{1}, C \frac{0}{0}, P \frac{2}{1}, M \frac{3}{3}$.

Found in Rocky Mountain areas from Idaho, Washington, and northern Montana; north to Arctic Circle in Alaska with races in the Cascades, Olympics, and other ranges. See prairie dog for "marmots" farther south. This species essentially a rock-pile animal. Some live south to New Mexico and California.

Pairs, mating in early spring, with 3-4 young born a few weeks later, or about June 1 in southern part of range. Young to be seen running with mother from late June to late August. Young probably sleeps with mother first winter. Apparently does not mature until 2 years old. Has a long hibernation.

Food essentially plants, often gathered some distance from home den, usually reached by long-established, well-marked trail. Must have good sight and hearing to escape bears, hawks, and other enemies which roam over exposed home territory. Its call, a shrill whistle, may be heard a mile away. Generally escapes enemies.

Serves in nature as food for animal eaters that roam mountains, and therefore may be considered a "buffer" species protecting more valuable animals from their natural enemies. Although they compete with sheep for fodder, they feed animals that might otherwise kill the sheep. Fur known as "Brazilian mink," durability 20%, is Russian marmot.

Prairie Dog *Cynomys ludovicianus*

Length to 14½ in., tail 3 in. Weight to 3 lb. Female to 2 lb. 4 oz. Reddish-brown, gray, or flesh-colored above, with pale muzzle and eyespot. Last third of tail black. Feet suited for digging. Has habit of sitting erect at entrance to burrow. 5 claws on each foot. Rudimentary cheek pouches.

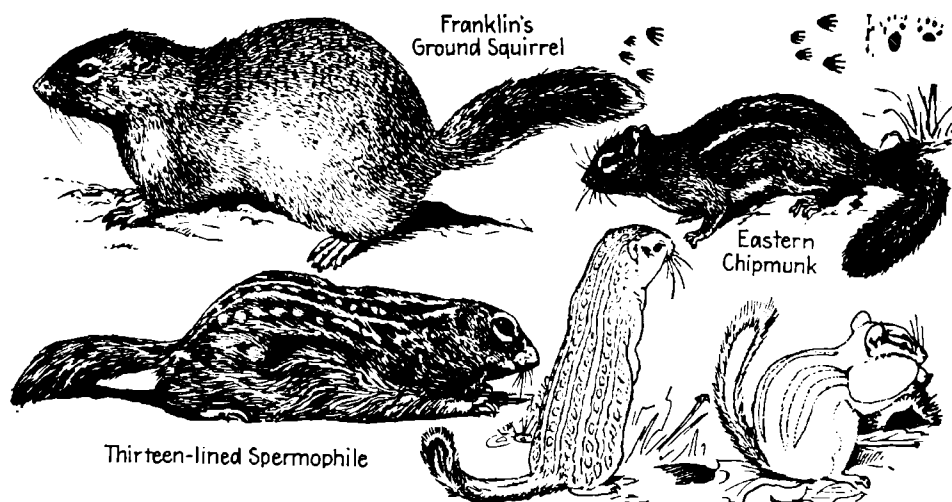
Teeth: $I \frac{1}{1}, C \frac{0}{0}, P \frac{2}{1}, M \frac{3}{3}$.

Lives in prairie lands from central North Dakota south to central Texas, west to northern Mexico, Arizona, Utah, and western Montana, being confined to open flat regions of dry clay soil. Close relative, white-tailed prairie dog, favors mountainous areas above 6,000 ft. in elevation.

3-4 young born April-June, weigh about ½ oz.; 2¾ in. long, smooth and shining. Increase 40% in weight in 7 days; thirteenth day, 2½ times birth weight; twentieth day, have hair and are able to stand; twenty-seventh day, crawl; thirty-third-thirty-seventh day, eyes open; at 7 weeks, weaned; at 9 months, over 2 lb. Breed at 2 years, bearing young once a year.

Lives probably on plants including vegetables, grains, pasture plants, and even some woody plants and insects. Lives in dens with deep plunge entrance, in which rattlesnakes and burrowing owls also live, but not with prairie dogs' consent. Although white-tailed species hibernates, black-tailed does not.

Burrow lets water into the ground but also serves to break legs of horses and cattle. Estimated that 32 prairie dogs eat as much grass as 1 sheep, and 256 as much grass as 1 cow. One authority estimated in 1900 that Texas supported 800 million prairie dogs, which are vegetation that would otherwise support over 3 million cattle. Coyotes, hawks, and owls are a check.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia. Family Sciuridae. SQUIRRELS

Franklin's Ground Squirrel
Citellus franklini

Length 14 in., tail $4\frac{1}{2}$ in. Closely related to 13-lined spermophile but uniformly colored grayish-white to dusky above, or brownish with faint light and dark dots; feet darker; tail black and white mixed, bushy. Sexes colored alike.

Essentially a ground animal though may take to trees. Individuals may never range over 100 yd. from den, but species found through central United States and Canada from Oklahoma and Illinois to Athabaska River, range being broader in South, narrow east and west in North.

Probably pairs, in spring, but male does not stay with family after breeding period. 4-8 young born blind, nearly naked and helpless, early in June; $3\frac{3}{4}$ in. long, with $\frac{3}{4}$ -in. tail; suckled about 6 weeks; $\frac{1}{2}$ grown by August, when begins to feed for self. 1 annual litter.

Eats plants, insects, mice, birds, or a great variety of related forms though it is not such a flesh eater as the 13-lined species. Some plant food may be stored. Probably requires more water than some near relatives. May migrate to new territory in a body, though not normally sociable.

Serves to check multiplication of insects and mice and to let air and water into the soil; however, destroys considerable forage more useful to cattle from man's viewpoint. Has a long winter hibernation until part of year when surplus is greatest. Appears about April, later than most relatives.

Thirteen-lined Spermophile, Gopher
Citellus tridecemlineatus

Length, total 11 in., tail $4\frac{1}{2}$ in. Female slightly smaller. Conspicuous because of alternate longitudinal stripes of dark-brown and dirty white; stripes on neck and shoulder broken into spots. Ears small. Tail only sparingly bushy. Tends to sit erect with head pointed skyward. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{2}{1}$, M $\frac{3}{3}$.

Found in open lawns and prairies from southeastern Alberta through Manitoba, Wisconsin, and Michigan to central Ohio; southwest through Indiana, Illinois, Missouri, and Oklahoma to Texas; west to Arizona, Utah, and central Montana, essentially in the plains and prairie country. Range probably expanding.

Mates as soon as appears above ground in April; male deserts female before 7-14 young are born about first of June, or in 30 days. Young completely naked, helpless, and toothless at birth; $2\frac{1}{4}$ in. long with $\frac{3}{4}$ -in. tail. Eyes open thirtieth day. Out of den in 35 days, fullgrown in 90 days. 1 litter.

Food, plant and animal matter, much of plant material being stored underground. Body temperature ranges from 86-95°F.; can survive 28.5°F. May lose $\frac{1}{3}$ body weight during hibernation. Soil temperature does not control hibernation. Has host of enemies, including hawks, cats, weasels, and parasitic insects. Often called "gopher."

Interesting member of prairie landscape. Probably does more harm to than good to man's crops. Confines activities to period when surpluses are most abundant so can do no harm to stored crops. Provides food for valuable fur bearers. Unquestioned enemy of small ground-nesting birds, mice, and insects. Pulse, 200-350 per minute when active, 5 when dormant. Temperature, 105.8-35.6°F.

Eastern Chipmunk
Tamias striatus

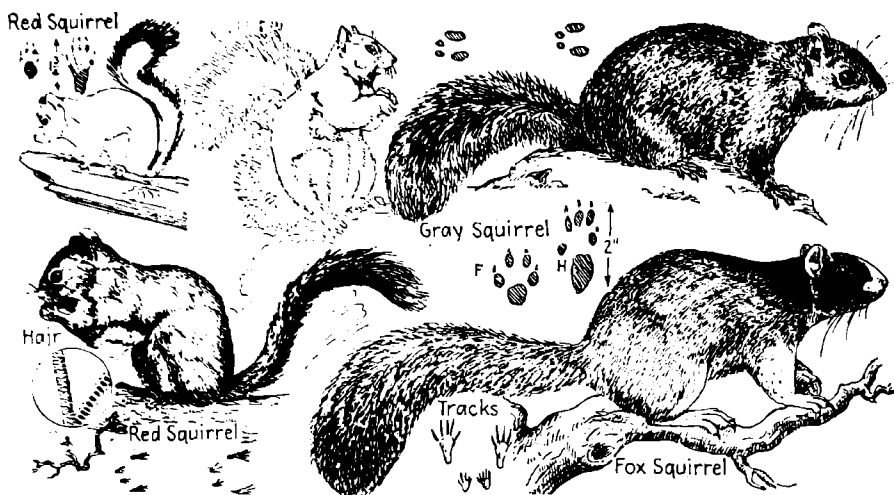
Length to $9\frac{1}{2}$ in., tail $3\frac{1}{4}$ in. Well-developed cheek pouches. Along back is series of conspicuous black stripes, usually 5, over brown or gray fur. Under parts light fawn-colored as are lower cheeks. Conspicuous dark streak with white beneath crosses eye. Throat white. Sexes alike. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{2}{1}$, M $\frac{3}{3}$.

In cultivated land and woodlands, from Nova Scotia west to central Wisconsin, northeast North Dakota, south to Louisiana, east through northern Mississippi, Alabama, Georgia, and western Carolinas to eastern Virginia and north to Nova Scotia. Closely related species occupy southern Canada and western United States except in plains.

4-5 young, blind, naked, and helpless at birth; born 32 days after breeding in spring or midsummer, though shows signs of fall breeding as well. Possibly 2 litters, 1 in spring and 1 in fall. Young stay with mother until $3\frac{1}{2}$ months old. Weigh 3 g. at 1 day; 12 g. at 8 days; 17 g. at 14 days; 25 g. at 21 days; 33 g. at 28 days; 50 g. at 35 days; 70 g. at 42 days; and 84 g. at 49 days.

Food a variety of plant and animal materials, including insects, young birds, other small animals, nuts, vegetables, and bulbs of garden flowers, individual ranging over 2-3 acres. Hibernation from first frost in fall to March, but not fat at beginning of hibernation. Variable with weather. Well-developed storage instinct, largely for plant materials.

Tremendously interesting little animals, whose habits are rather destructive to garden flowers, nesting birds, and certain fruits and garden plants. Tamed reasonably easily so that they will eat out of the hand or even from the lap, so are popular with bedridden folk living near their haunts. Tracks: F $\frac{1}{2} \times \frac{3}{8}$, 5; H $\frac{3}{4} \times 1\frac{1}{4}$, 5; Sp 2.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia. Family Sciuridae. SQUIRRELS

Red Squirrel
Tamiasciurus hudsonicus

Length 12½ in., including 4¾-in. tail. Active, with flattened bushy tail. Ears fairly long. Sexes colored alike. In winter, grayish-white beneath, rusty red above. In summer, clear white beneath, brighter red above, and tail less buffy. 2 color phases and over 20 closely related species and subspecies. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{2}{1}$, M $\frac{3}{3}$. Tracks: F $\frac{1}{2} \times \frac{3}{4}$, 5; H $1 \times 1\frac{3}{4}$, 5; Sp 3; L 36.

Favors evergreens, though common in parks, street trees, and orchards where food is available, through most of forested America north of Mexico. The *hudsonicus* group is in the east, *fremonti* in the Rocky Mountains, and *douglasii* west of the Rockies. No near kin in Old World species superficially similar.

Mates in February–March. 3–6 young, under 1 oz., born in about 40 days; blind, naked, helpless; 4½ in. long, including 1½-in. tail. Eyes open twenty-seventh day. Weaned in 5 weeks. Family stays together during summer. 2 litters a year. Mother obviously teaches young to become independent. Life span to 12 years.

Food, plant and animal matter. One may eat possibly 200 birds a season and therefore be worse than a domestic cat. Eats seeds from many cones, including pines and hemlocks, also apples and other fruits. In eating hickory nut makes one elliptic opening with rough edges. Can cover 75 ft. in 8 seconds over level ground.

Probably difficult to defend economically. Fur of no commercial value though it sells for 15 cents. One eastern state in 1 year killed over 7,000 as vermin but their gay actions through year except in severe weather win the species many friends who would dislike to see the last one vanish. Important as hider of cones and tree planter.

Gray Squirrel
Sciurus carolinensis

Length 18 in., including 9-in. tail. Weight about 1 lb. Pepper-and-salt gray over slate-colored underfur; hairs white-tipped over black, buff, and lead. Black squirrels are color phase of gray. Albinos also known. Tails large and beautifully plumed. 5 cheek pouches on each side. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{2}{1}$, M $\frac{3}{3}$. Tracks: F $1 \times 1\frac{1}{2}$, 5; H $1\frac{1}{4} \times 2\frac{1}{2}$, 5; Sp $3\frac{3}{4}$; L 60.

Usually in lands of woods and orchards from Maine to Dakotas, south through central Texas and east to Atlantic and Gulf coasts. Spectacular migrations of large numbers take place periodically, possibly but not necessarily because of overcrowding as they often leave abundant food for regions of scarcity.

Mates in spring (January?), believed by some authorities to pair for life. 1–6 young, born 44 days after breeding; blind about 37 days, when weight has reached about ¼ lb.; stay with mother at least for season or until full-grown; can leave den in 6 weeks; full-furred at 9 weeks. 2 annual litters in North.

Food largely plant material but also some animal matter. A hickory nut is cut into many pieces or heavy fragments. Food not stored in large amounts in one place but hidden separately and later located by scent. Food not taken to nest of young. Has remarkable sense of smell. Den kept clean, as is leafy nest in treetop used for hot weather.

Undoubtedly useful as planter of nut trees, including white oak acorns that may sprout and freeze unless buried. Also considered valuable as a game species. Pelt has some slight commercial value. Well liked because of friendly ways in parks and about homes.

Fox Squirrel
Sciurus niger

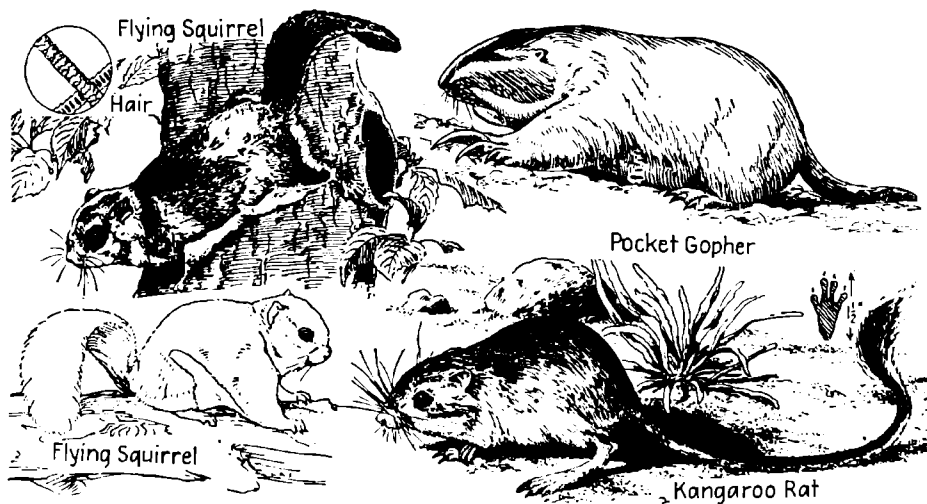
Length 2 ft., including 1-ft. tail. Weight nearly 3 lb., male slightly the larger; Florida animals probably largest. Color varies from black with white ears and nose to buff above and lighter beneath, or gray above with white under parts, nose, ears, and feet but black crown. 4 cheek pouches on each side. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{1}{1}$, M $\frac{3}{3}$. Tracks: F $\frac{3}{4} \times 1\frac{1}{4}$, 5; H 1×2 , 5; Sp 6; L 60.

Found from Rhode Island through southern New York and Minnesota to southeastern South Dakota; south through central Texas to Gulf; east to Atlantic coast with related forms in small areas in Cascades, Olympics, and New Mexico, Arizona, and Mexico regions. Generally coincides with range of oaks but not of hickories and chestnuts.

Probably pairs, breeding in December–January. 2–5 young, small, blind, naked, helpless and pink; born probably about 6 weeks after breeding; nursed about 5 weeks; can leave nest in 6–12 weeks; leave parents at about 3 months, when new family may start if there are 2 litters a year as in warmer ranges.

Food fundamentally nuts and other tree fruits, many being buried for future use, not in a few large piles but in small widely scattered units. In this way squirrel assists in planting many trees. Food also includes buds, bark, and birds, the last sometimes to an unfortunate degree. Has excellent sense of smell.

Useful in planting hardwood forests, as a street and park pet, and as a game animal; since it does not hibernate, interests nature lovers through year. Bird-eating habit apparently is not universal but is always unfortunate. Large size makes it popular game and its flesh is good. Should not be exterminated.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Rodentia

Family Sciuridae

Flying Squirrel *Glaucomys volans*

Length to $9\frac{1}{2}$ in., including $4\frac{1}{2}$ -in. tail; larger *sabrinus* species totaling 1 ft. with a 6-in. tail. Color of *volans*, drab above, ringed with reddish and pure white belly; *sabrinus*, drab above, and dirty white beneath. Extensible fold of skin along sides. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$.

P $\frac{2}{1}$, M $\frac{3}{3}$. Tracks: F $\frac{1}{2} \times \frac{1}{2}$, 5; H $\frac{3}{4} \times \frac{1}{4}$, 5; Sp 2.

Essentially animals of treetops. Smaller form found from Maine to Minnesota, south to central Texas and Gulf and east to coast. Larger form, from mouth of St. Lawrence to southern Mackenzie, south to central Alberta, northern Minnesota, and northern Wisconsin, Michigan, New York, and New England; other groups, in Alaska and the Rockies.

Pairs, in winter; 2-6 young born March-April after 40 days. Blind 4 weeks. Possibly 3 litters. By fortieth day, young squeak, not light-sensitive, weigh 1 oz.; by seventy-fifth day, storage instinct developed, $1\frac{2}{3}$ oz.; one hundred-third day, light-sensitive, 2 oz.; one hundred-seventeenth day, shedding fur, $2\frac{1}{2}$ oz.; one hundred-twenty-fifth day, new coat, "churr," $2\frac{1}{2}$ oz.

Stores food of tree fruits, superficially. Opens a hickory nut with one elliptic opening showing ground edges. Most nocturnal American mammal. *Sabrinus* active all winter. Has a clean den in a tree hole. Can cover 75 ft. in 12 seconds on ground or glide through air 152 ft. from 60 ft. elevation, rising slightly at end of glide.

Most interesting animal and make trusting pet, but may be annoying in attics and houses generally or may destroy some stored fruits. Also known to eat flesh even of its own kind, though this is probably exceptional. Too small and nocturnal to be considered as game but always worth watching when opportunity presents itself.

Family Geomyidae

Pocket Gopher *Geomys burarius*

Length, male 1 ft., with $3\frac{1}{2}$ -in. tail; female, $10\frac{1}{2}$ in., with 3-in. tail. Outer surface of upper incisor teeth grooved; in western genus *Thomomys*, not grooved. Husky, short-necked, strong-clawed with pair of fur-lined cheek pockets opening outside mouth. Reddish, sprinkled with black, darker above. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{1}{1}$, M $\frac{3}{3}$.

Animal of clayey plains. Over 80 western (*Thomomys*) forms from south central Mexico to Washington through Rockies, with relatives including *Geomys* extending range east to Mississippi, with another group in Florida, Georgia, and Alabama. Central group extends north to central Alberta and Saskatchewan.

Midwest species bears 2-8 young in April. Probably only 1 litter a year, although half-grown young have been found through to September, when families usually break up and scatter to new territory. Individual range may be confined to $\frac{1}{4}$ acre for the season.

Food, vegetable materials carried in cheek pouches, stored underground in an orderly manner, roots and stems commonly cut in 2-in. lengths. Apparently does not drink. Digs elaborate burrows with strong claws, pushing loose dirt out with head and forefeet but not carrying it in cheek pouches. Mostly solitary in habits.

May serve to let air and water into soil, but also undoubtedly destroys considerable quantities of valuable plant materials and may injure grasslands where it is desirable that they be flat for lawns and golf courses. Highly sanitary in burrows, leaving wastes at established place. Has many enemies including body parasites and snakes.

Family Heteromyidae

Kangaroo Rat *Dipodomys deserti*

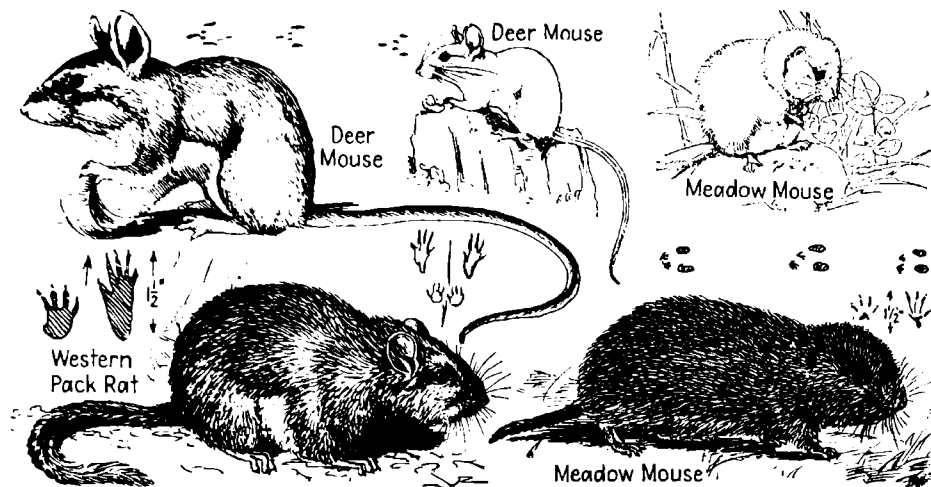
Length to 13 in., including $7\frac{1}{2}$ -in. tail. Forelegs small. Hind legs long, hind feet over 2 in. long, with 4 toes. Ears short and rounded. Eyes, large and beautiful. Cheek pouches well developed, external, fur-lined. Whiskers long and conspicuous. Color: bluish fawn above, gleaming white beneath, even on tail and tail tuft. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{1}{1}$, M $\frac{3}{3}$.

Found in dry, clayey, or sandy grounds; some species in damp lands; some in forests from Washington and Manitoba to Panama. This species, from western Nevada through Arizona and eastern California. Square mile may support 1,000 animals. Nearly 100 kinds of kangaroo rats known. Most seek dry, hot lands where coolness exists underground.

Social, even though families commonly live separately in tunnel homes. Underground nest lined with fine plant material contains 2-4 young, in April and probably at other times during summer. Nest room about 8-10 by 5 in. and may be 3 ft. underground where it is cool; clean and separate from dung areas.

Food probably solely plant material such as seeds and roots, stored by larger banner tail but not by smaller species; gathered in night forays when a rat may leap 8 ft. at a jump and of course easily escape most of its enemies. Does not hibernate or migrate. Fights by striking with hind feet and squeaking. Friendly.

Of little economic importance but tremendous interest. Helps let air and water into soil by burrows. Might destroy grain if it lived in grain country. Makes excellent pet and should be better known to be appreciated. Night trails, songs, mounds, and escapes are worth investigating.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia. Family Cricetidae. MICE

White-footed Mouse, Deer Mouse
Peromyscus leucopus

Length to $7\frac{1}{2}$ in., including $3\frac{1}{2}$ -in. tail. Medium-sized, with large ears, large eyes, and rather long head. Fawn-colored with under parts clear white or, when young, slate-gray in some species on back with under parts gray or white. Feet white. Teeth: $I \frac{1}{1} C \frac{0}{0} P \frac{0}{0} M \frac{3}{3}$ Tracks: $F \frac{3}{4} \times \frac{1}{4}$, $S: H \frac{1}{4} \times \frac{1}{2}$, $Sp \ 1\frac{1}{4}$.

Varied habitat, including fields, woodlands, and dwellings, species and subspecies covering most of United States and parts of southern Canada. *Leucopus* extends from Nova Scotia to South Dakota and south through to New Mexico, with related species taking most of Gulf Coast areas and others to west.

Young born 21 days after breeding; at birth $1\frac{1}{2}$ in. long; eyes open eighteenth day; cared for by mother; weaned at 14–20 days; $\frac{1}{2}$ grown at 3 weeks; $\frac{3}{4}$ grown at 42 days; female matures at 28 days, conceives at 39 days; male matures 10 days later; old at 3 years; breeds to 33 months. Life span to $5\frac{1}{2}$ years, but usually shorter.

Food about evenly split between plant and animal materials, some plant materials being stored. Elaborate house of plant materials is constructed either by remodeling abandoned bird's nest in a tree or selecting some place under a board, in a wall, or in a house. Often enters houses in winter for shelter but leaves in summer.

Causes the usual damage of mice in a dwelling and may do some damage to crops in fields but does not compare in this destruction with meadow mouse; has saving habit of eating considerable quantities of insects. Is always interesting to watch unless it is where it can do damage.

Pack Rat
Neotoma cinerea

Length $15\frac{1}{2}$ in., including $6\frac{1}{2}$ -in. tail. Weight, $\frac{1}{2}$ lb. Rather heavily furred, with somewhat flattened bushy tail. Ears relatively large. Gray to reddish-brown above, with sprinkling of dusky hairs. Beneath, white or nearly so. Eastern, southern, and some of western species lack bushiness of tail. Teeth: $I \frac{1}{1} C \frac{0}{0} P \frac{0}{0} M \frac{3}{3}$.

Found through the Northwestern states and British Columbia, with species *magister* from Pennsylvania to Alabama; *floridana* from South Dakota to Gulf States; 1 dusky-footed *fuscipes* along Pacific Coast; 3 Mexican border species and 2 small (under 13 in.), *desertorum* and *lepida*, in California, Utah, and Arizona.

Probably monogamous. Breeds probably January–February, bearing 2–4 young from February–May. Young usually open eyes by 17 days; are weaned at 3 weeks, though may stay with mother longer. Father not allowed with family while young are present. Mother an exceptionally good parent.

Food a variety of plant and animal materials, including principally nuts, grain, and berries, which may be stored in a single large hoard of nonperishable kinds. Storehouse usually separate from an elaborate nest of vegetable material. Also has habit of gathering many inedible materials and bringing them together.

Useful in gathering nuts and acorns which are stolen by men and sold. Useful as food, flesh being edible and animal relatively easily caught. Probably cause of many misunderstandings among men because of habit of stealing small objects, even though usually something worthless is left in exchange.

Meadow Mouse, Vole
Microtus pennsylvanicus

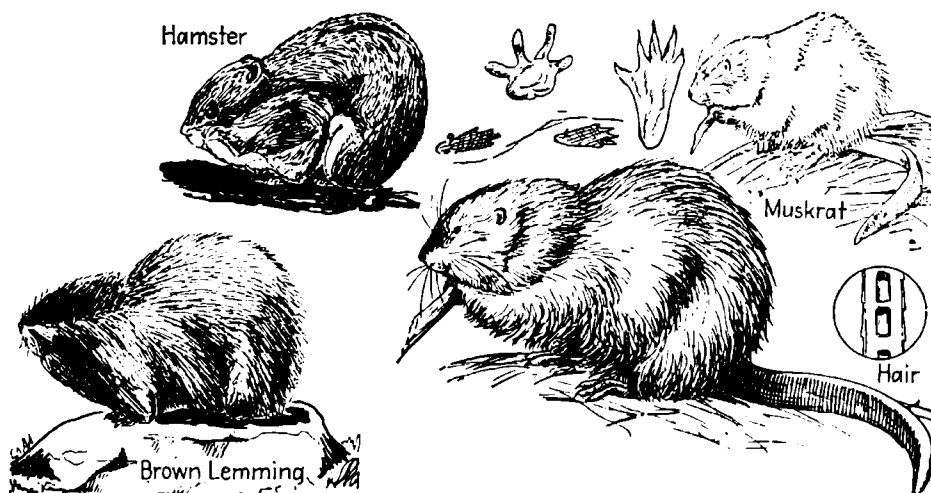
Length to 7 in., with $1\frac{1}{2}$ -in. tail. Sexes colored alike, a uniform chestnut-brown above sprinkled with black; gray beneath, sprinkled with cinnamon. In winter gray and in youth darker. Tail not bushy. Eyes and ears small. Face blunt. At least 13 groups of related mice include over 70 species. Teeth: $I \frac{1}{1} C \frac{0}{0} P \frac{0}{0} M \frac{3}{3}$ Tracks: $F \frac{1}{2} \times \frac{1}{2}$, $S: H \frac{1}{2} \times \frac{3}{4}$, $Sp \ 1$.

Practically all North America is home of mice of this type including groups *pennsylvanicus*, *montanus*, *californicus*, and *mexicanus* whose general range is indicated by name; also *abbreviatus* and *operarius*. *M. pennsylvanicus* is found from Nova Scotia to Dakotas to British Columbia and south to North Carolina. Abundance cycle, about 4 years.

Females possibly produce 13 litters before end of year. Promiscuous. 4–8 young born 21 days after breeding, followed by immediate breeding by mother. Young weaned in 10–12 days. Female breeds when 1 month old, male at 45 days. One female may produce 100 mice a year. Life span about $1\frac{1}{2}$ years.

Requires water but eats almost exclusively plants, (its own weight in a day) one requiring about 23 lb. of green food per year but destroying much more than that, since cut material is not all cleaned up. Active day and night throughout year, girdling trees, eating vegetables and forage. Forms basic food of most flesh eaters and buffer crop for game.

Destroys orchards and farm plant products and in United States, at least 3 million tons of hay a year, being worst competitor of domestic animals for forage. 1 acre may support 300 mice, but population of 12,000 per acre is recorded. Has some storage instinct and is clean in home. "The meek shall inherit the earth" fits them perfectly.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Rodentia. Family Cricetidae. MICE

Collared Lemming *Dicrostonyx rubricatus*

Length to 6 in. Weight to 4 oz. No external ears. Feet short and thick, with middle claws of forefeet long. In summer gray above dappled with rusty red, with black line down back and dull gray with mixed rusty below. In winter nearly pure white but with black hairs mixed in. Some show a whitish collar with a brown border. Brown lemming *L. alascensis* is shown above.

Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{0}{0}$, M $\frac{3}{3}$

Found from barrens of northern Alaska to Labrador but not much south of barren lands. Closely related species extend range around world on both hemispheres but only in north. Related Norway lemming has small round ears, yellow under parts, and third claws of forefeet the longest; best known in Scandinavia where it digs dry shallow burrows.

About 5 young in a litter, with many litters a year, thus making enormous increases in population possible. When this occurs with Norway lemming, great numbers may start on migrations in which they stop at nothing, swimming lakes, invading cities, and of course perishing in enormous numbers and thus keeping population within bounds. Migrations of this nature not typical of this species.

Food almost entirely plant material gleaned in reasonable safety from protection of shallow burrows. Are preyed on by foxes, owls, weasels, and similar animals providing basic food for most fur bearers that yield an important portion of natural wealth of North. Without lemmings and their kin, fur trade probably could not exist. Abundance cycle, 3-5 years.

Have been eaten by starving men. Skin of no value either when white in winter or in darker summer condition. Reported that American lemming makes a reasonably satisfactory pet but that Norway lemming may fight any animal that may oppose it in its migrations. To most people, these animals appear simply as "meadow mice" in summer.

Hamster *Cricetus cricetus*

Slightly smaller than Norway rat (6-in. body) but with hair-covered $\frac{1}{2}$ -in. tail, with thickish head, round ears, and mouth with internal cheek pouches used in storing food. Forefeet with 4 toes, hind feet with 5 toes, all strongly clawed. Fur fine, long, usually red-gray above and white below but sometimes all black. Legs short.

Native of temperate Europe and Asia but especially abundant in Syria where it lives normally in or near grainfields in a burrow 3-6 ft. deep, with straight, perpendicular tunnel entrance and large grass-lined sleeping chamber with sloping entrance. May maintain 4-5 storerooms, each capable of holding a peck of grain.

Males fight for females. Normally 7 but sometimes to 15 young born 15 days, 21 hours after mating. Young at birth weigh $\frac{1}{10}$ oz., at first naked, pink, and blind. Backs black at 3 days. At 12 days, weigh $\frac{1}{4}$ oz. and are golden brown. At about 13 days are weaned; can see at 14 days. Independent at 21 days. Breed at 43 days. Females bear young at 59 days. Monthly litter through year. Old at 2 years.

Food in summer, small animals; in winter, stored grains. In captivity, live on lettuce, dog biscuit, and corn. Live comfortably at 70°F. but hibernate at 45°F. Have many enemies such as hawks, snakes, and weasels. More susceptible to human diseases than are guinea pigs. Very cleanly in habits. Stored food suitable for human consumption.

In native land are used as food and fur has value. Also food caches are robbed by man for his use. Make good pets because of friendliness. In 1938, introduced into United States as a laboratory animal for studying nutrition and disease, and bid fair to supplant mice, guinea pigs, and white rats to some extent for these purposes.

Muskrat *Ondatra zibethica*

Length to 25 in., tail 10 in., compressed, sparingly haired, and scaly. Weight $1\frac{1}{2}$ -3 lb. Head rather round. Fur dark, uniform brown above, with longer hairs darker. Under parts gray. Sexes colored alike; young resemble adults. No seasonal change. Ears short, close, and round. Tail leaves conspicuous track. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{0}{0}$,

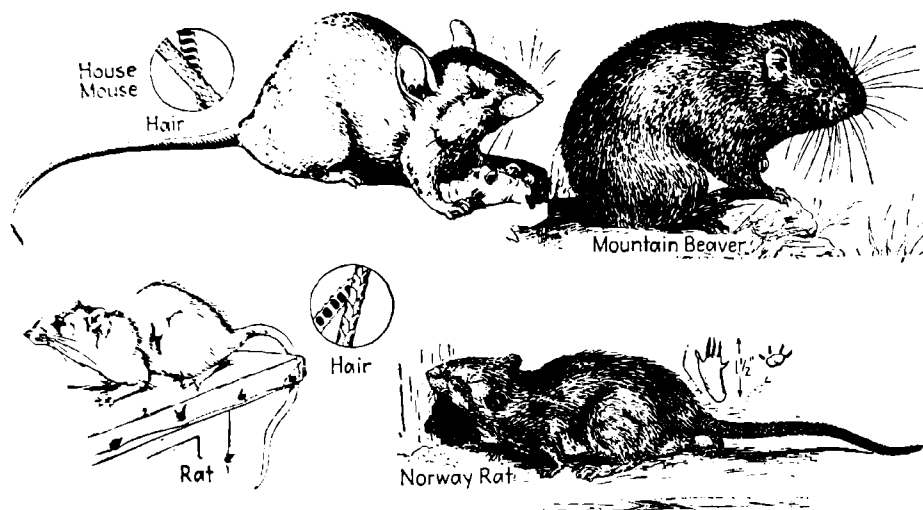
M $\frac{3}{3}$. Tracks: F $1\frac{1}{2} \times 1\frac{1}{4}$, 4; H $3\frac{1}{2} \times 1\frac{1}{4}$, 5; Sp 3; St 8.

Found in waterways and marshes in shallower parts, from Alaska through all of Canada except northernmost areas and through all of United States except extreme southeast, including Florida, most of eastern Texas, practically all of California, and southern Oregon. Numbers decreasing where harvest is not wisely handled. Is not raised economically in confinement.

Probably polygamous. 4-9 young born about 29 days after breeding. First litter appears March-April; last of 3, which is usually largest litter, appears in late summer. Mothers fight effectively to protect young, probably without cooperation of male.

Food largely plant materials, stored at times; also shellfish such as fresh-water mussels and other small aquatic animals. Enemies include hawks, minks, otters, owls, and, most of all, trappers. Lives in burrows in bank or in houses of nonwoody marsh plants piled high above water line, with generous room inside and underwater entrance.

Possibly most valuable of all wild fur bearers because of great numbers and availability. Pelts worth up to \$4; known in trade as Hudson seal, Russian otter, red seal, river mink; durability 45% that of otter.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Rodentia

Family Muridae

House Mouse

Mus musculus

Length to 7 in., tail $3\frac{1}{2}$ in. Sexes colored alike a uniform brownish-gray with under parts somewhat lighter. Tail only sparsely haired. Hair short and close. Nose pointed. Ears relatively large and erect. Head relatively long. Body more slender than associated common mice. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$,

P $\frac{0}{0}$, M $\frac{3}{3}$. Tracks: F $1\frac{1}{4} \times 1\frac{1}{4}$, S; H $1\frac{1}{2} \times 3\frac{1}{4}$, 5; Sp $1\frac{1}{2}$.

Found in houses, fields, and waste places through most of North America and other continents, outdoor animals being found in more temperate regions. Probably originated in Asia and came to America with settlers after making way through Europe. Common on ships of world.

Probably does not pair but breeds promiscuously, young appearing at any time of year in litters of 4-11, 21 days after mating. Weaned in 3 weeks. Female breeds at 2 months of age. A pair theoretically could have 1,000 descendants in a single year with abundant food and no enemies to cut down numbers. Life span to 4 years.

Food, a variety of plant and animal substances, either growing freshly in fields or stored in houses or granaries. Storage instinct developed only slightly, cleanliness not practiced, and animal does not hibernate. Individuals may have a sweet squeaking song.

Populations to 17 per sq. yd. or over \$2,000 per acre have been known in California, but this is abnormal. Probably, next to the rat, one of most destructive mammals, injuring wood-work in houses, fouling books and stored clothing, and carrying diseases, including spotted fever.

Norway Rat

Rattus norvegicus

Length of body of year-old animal, 9 in. Weight $\frac{3}{4}$ -1 lb. Norway rat brown. Black rat smaller and darker. Albino or "white rats" are almost entirely forms of Norway rat, although albino black rats are known. Wild Norway rat is fierce fighter, persistent and sometimes dangerous. Laboratory white rat is relatively harmless. Teeth:

I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{0}{0}$, M $\frac{2}{3}$. Tracks: F $1\frac{1}{2} \times 1\frac{1}{2}$, S; H $1\frac{1}{2} \times 1\frac{1}{2}$, 5; Sp 4.

Norway rats live in fields, marshes, woods, in towns, on farms, in houses from China, Japan, North America, and elsewhere, wherever man lives. Came into Europe in eighteenth century: to England about 1729, Prussia 1750, Paris 1792, and United States 1775, following house rat of Europe here by about 250 years. Did not originate in Norway.

Mates promiscuously at any time of year. About 6 young born 22 days later, blind, naked, and helpless. Ears open in 3 days, eyes in 14-17 days. Become sexually mature in 2 months. Double weight 6 days after birth. Cease breeding at 18 months. Old at 3 years. In wild produces 6 annual litters. Lives 30 times faster than man.

Food, almost any organic substance. Will attack humans, and has killed pigs and calves. Responds to diet as does man. Will work in unison to obtain food. Subject to many of man's diseases. Carrier of bubonic plague, trichinosis of swine, tuberculosis of poultry. Black rat survives cooler climate, is less aggressive than Norway rat. Respiration, 100-150.

Wild Norway rats destroy about 200 million dollars' worth of agricultural products yearly in United States and 20 million dollars' worth in Canada. Our worst pest. 1 part of barium carbonate to 4 of soft food is an effective but dangerous poison control. Albino rat is one of most useful animals in studying man's diet and diseases, ranking with guinea pig, hamster, and monkeys.

Family Aplodontiidae

Mountain Beaver

Aplodontia rufa

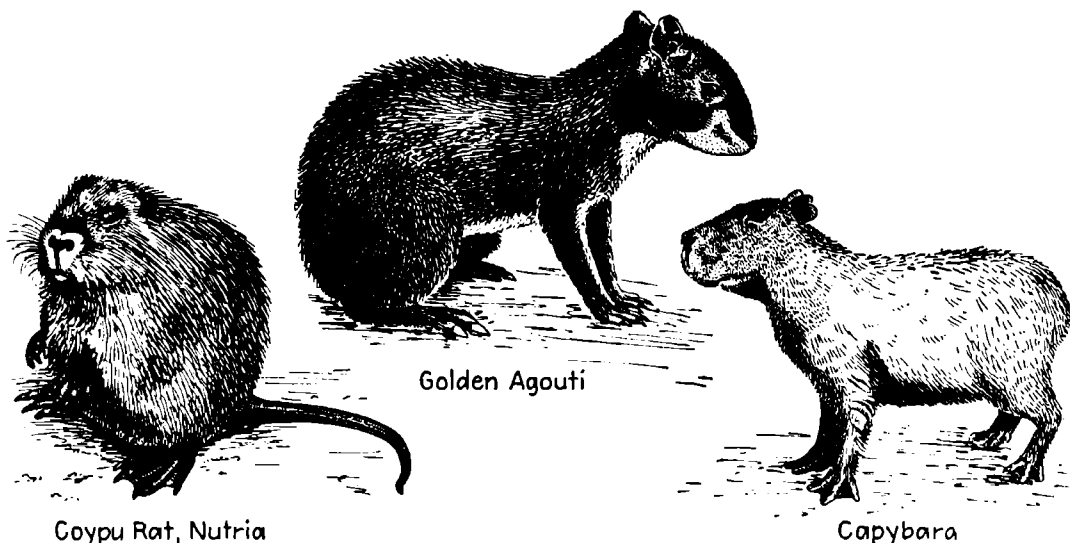
Length $13\frac{1}{2}$ in., tail $\frac{1}{2}$ in. Weight to 4 lb. Like a short, tailless, chunky, short-eared woodchuck or rabbit in general appearance. Light reddish-gray above, sprinkled with black, with a white spot at base of ears. Young darker than adults. Adult females with prominent dark spots around nipples. Teeth: I $\frac{1}{1}$, C $\frac{0}{0}$, P $\frac{2}{1}$, M $\frac{3}{3}$.

Limited in range to northern and eastern California and western Oregon and Washington, where there is dense forest and mild climate. Usually where there is deep soil which can be easily tunneled. Also, water must be present in abundance. 9 races recognized.

Probably mates promiscuously February-March, but this is not certain. 2-4 young born 6-8 weeks after breeding; with closed eyes but well furred; usually half grown and out of den by June. Male does not assist in rearing young.

Food probably solely plant material, much of which is dried after being cut, then stored neatly in underground rooms. This stored material may also be used for bedding purposes. Sometimes storerooms for these materials are sealed with earth. Requires drinking water in great abundance at all times.

Probably relatively harmless because of type of country it inhabits. May influence direction of flow of water underground much as beavers stop its flow with dams above ground. Burrows are generally free of wastes. Pelts are of little commercial value.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia

Family Myacastoridae

Coypu, Nutria
Myacastor coypu

Length with tail, to 3 ft. but usually smaller. Tail $\frac{3}{4}$ as long as body proper, scaly or thinly covered with short hairs. Weight to 20 lb. Pelt long, dusky to brownish-yellow fur with long guard hairs covering a dense, soft, yellowish underfur. Best fur on the under parts. Hind feet webbed. 4 prominent yellow front teeth and long gray whiskers.

Native of both sides of the Andes from Peru southward, where the animals live in the banks of waterways in burrows that they dig. In the 1930's a few were introduced into the United States for rearing as fur bearers. About 1940 several hundred were washed from their enclosures by floods and have since spread over an area 300 miles across in the lower Mississippi delta and to the western Texas border, so that by 1948 season we had a harvest of 50,000.

At 6 months of age a female may begin breeding and is capable of producing 3 to 12 rat-sized offspring every 4 months. Young nurrias swim within a few hours after they are born and can produce a litter of young in the same season in which they are themselves born. Growth may continue for 2 years, but animals can yield commercial pelts the first season. Females rarely live over 3 years; males live over 6.

Food is primarily the foliage, roots seeds, and other parts of aquatic plants, and an old generic name describes the animal as a "river mouse" rather than as a "mouse beaver," as the present name implies. Call is a low, piglike grunt, often reaching chorus proportions at dusk. Nutria are mentioned in the game laws of some states but may become pests.

Properly cured, the fur, which is taken from the underside of the body, may yield a valuable pelt for use in fur coats. It closely resembles the more expensive beaver and may soon offer competition for the all-important muskrat. The coarse hairs of the back are used in making felt for hats, thousands of animals being killed in South America for that purpose alone.

Family Dasyproctidae

Golden Agouti
Dasyprocta aguti

Slightly larger than a rabbit but with slender legs and only the shortest of tails. Feet have been described as being like those of a deer, but this is inadequate. Forefeet have 5 toes and hindfeet, 3 toes. Fur is rich olive above and yellow-white beneath, with the rump amply supplied with long orange hair. Eyes are large and appealing. Ears are relatively small.

Found mostly in forests or wooded lands from southern Mexico through some of the West Indies and into tropical Central America and South America. There are about a dozen closely related species living more or less in the same part of the world. The animals may adapt themselves to the dwellings of human beings and may live there as pets if provided with adequate protection.

The young, 5 or 6, are born 64 days after the parents have mated. They are well developed at birth and may attempt to nurse even before they are completely born. They have been known to begin nibbling at leaves within an hour after they are born and, as may be expected, soon become independent of the mother for food; however, families may remain together for some time. Young, become readily tamed.

Food of agoutis is chiefly plants, including almost any part that is edible to animals. With their sharp teeth they can get the meat from very hard nuts. Agoutis are largely nocturnal, usually holing up for the day in tree cavities or in holes underground. They are the prey of most of the larger flesh eaters of their environment, including, the ocelot and jaguar.

Agoutis may destroy some crops. Since their flesh is white, tender, and deliciously flavored, the animals are sought as a source of wild food. They are found in zoos in many parts of the world. They are not considered as of great economic importance except when they may occur in considerable numbers and offer competition for crops favored by man.

Family Hydrochoeridae

Capybara, Water Pig or Cavy
Hydrochoerus capybara

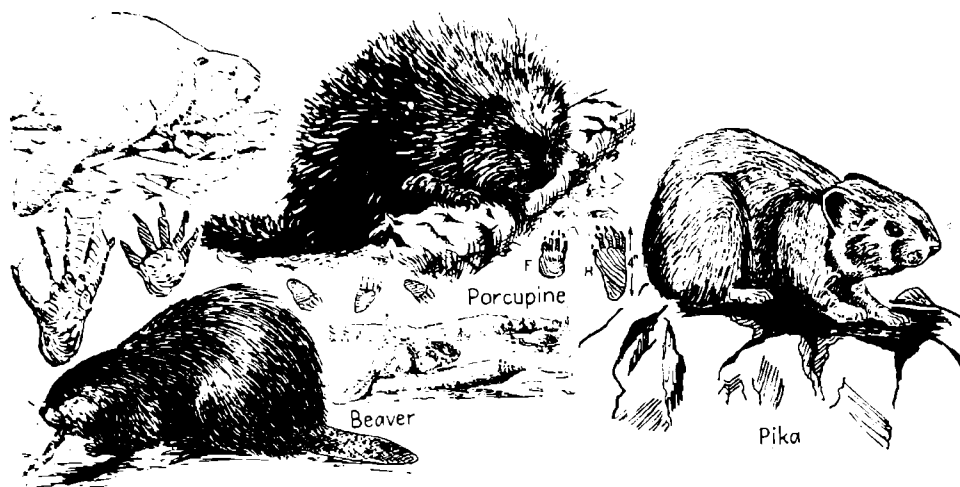
Length to 4 ft. with no tail. Weight to 100 (?) lb. or more, making it the largest of the rodents. Hind legs are moderately long and are longer than the front legs. Neck short. Ears small. Head broad. Forefeet have 4 toes; hind feet, 3. Toes have short webs and short nails. Hair is long, coarse, reddish brown above and brownish yellow beneath.

Native of South America, where it is found west to the foot of the Andes. It is almost wholly aquatic, living in rivers, lakes, and marshes, but it can run on land and may be seen there feeding on grass very much like a horse. Marshes and wet woodlands are equally popular with the animals. This largest of the living rodents is now confined to eastern South America.

The young, 3 to 8 in number, are born from 119 to 126 days after mating takes place. They are rather well developed at birth. They are able to feed independently of the mother at an early age, but the animals of a family may stay together for some time. They may spend much time on shore feeding on grass and other vegetation, but when disturbed they may hasten to water, dive, swim long distances submerged.

Food is almost exclusively plants, of which they eat prodigious amounts, gathered either in the water or on drier ground. When kept captive in parks, the animals become attached to their attendants and are friendly to visitors, but in the native state they are necessarily shy. They are not fighters but prefer to defend themselves by escape. This they do most readily.

The flesh is considered delicious by some and inedible by others, but it is not sought sufficiently for the animal to have been domesticated as a source of fleshy food for man. The animals are hunted with dogs that chase them into streams. There they are pursued by men in canoes who kill them when they come to the surface. Their conspicuous incisor teeth used ornamentally.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia

Family Castoridae

Beaver

Castor canadensis

Length 43 in., tail 16 in. long by $4\frac{1}{2}$ in. wide, broad, thick, paddle-like, and essentially naked. Weight to 60 lb. or more, average 30 lb. Front feet with 5 toes. Hind feet with 5 webbed toes. Brown, with beautiful soft close underfur. Sexes colored alike with little age or seasonal variation. Teeth: $I \frac{1}{1}, C \frac{0}{0}$

$P \frac{1}{1}, M \frac{3}{3}$

Originally found through Canada and Alaska, south to Mexican border except in southern Nevada and southern California, and to Gulf of Mexico except in Florida and southeastern coast region. Extirpated from much of plains, the Mississippi, and settled East but being restored locally. An animal of headwaters, where it builds \$3,000 dams free.

Apparently mates for life. Breeds early in year. 2-8 young are born 3 months later. At 1 month, young eat and seek solid food; cease nursing at 6 weeks; weigh 8 lb. by midsummer; mature at 3 years, when new home is established and surplus 2-year-olds are crowded out of community. Life span to 16 years. Tracks: F $2\frac{1}{2} \times 3\frac{1}{2}$, 5; H $5\frac{1}{2} \times 7$, 5; St 16.

Food exclusively plants, largely bark of softwoods felled near shore, cut up, dragged to water, and stored underwater for winter use. Full meal, 3 lb. of poplar bark. Den a house surrounded by deep water with underwater entrance, with large ventilated, dry room protected by sticks and frozen mud. Dams maintain water level. Tail not used as shovel.

Normal price for prime pelts, \$18. Spring pelts to \$55 in 1942. 7 open seasons in New York before 1940 yielded 22,000 pelts worth \$374,000, from 20 animals introduced in 1901. Was formerly a basis of natural wealth and a medium of exchange. Role of beavers' dams in flood control and soil building only recently appreciated as more valuable than fur. Flesh edible.

Family Erethizontidae

Porcupine

Erethizon dorsatum

Length to 36 in., tail 6 in. Weight to 40 lb., with average about 15-20 lb. Male slightly the larger. Brownish-black sprinkled with black-tipped, white-based quills, which are shed but not shot and which show chiefly on tail and rump. Tail swung in defense. Front teeth bright orange. Teeth:

$I \frac{1}{1}, C \frac{0}{0}, P \frac{1}{1}, M \frac{3}{3}$

Found in deeply wooded areas from mountainous West Virginia northeast across mouth of Gulf of St. Lawrence, west across Hudson Bay and northern Canada to north of Arctic Circle in Alaska south to central California and New Mexico except southern Nevada and western Utah, east to North Dakota and thence to West Virginia.

Female courts in November. Males do not fight. Single young born 16 weeks after breeding; eyes open at birth, 11 in. long, weight $1\frac{1}{2}$ lb.; waddles in 6 hours, climbs second day, nurses 1 week; $3\frac{1}{2}$ lb., 18 in. at end of first summer; 8 lb., 21 in., second summer; 12 lb., 25 in. and mature, third summer.

Food almost exclusively plants, favoring salty substances and evergreen foliage, but also eats water plants, tree bark, and other substances usually collected at twilight, at dawn, or in moonlight. Is slow and stupid, not particularly clean or sociable; does not hibernate; makes crude nests in cavities in trees or rocks. Tracks: F $2\frac{1}{2} \times 3\frac{1}{2}$, 4; H $4\frac{1}{2} \times 2$, 5; St 12.

Dangerous to dogs and other animals because of quills but useful to persons lost in forests as it can be killed easily and flesh is good to eat. Does great damage when too abundant because of habit of girdling trees. Makes relatively interesting pet. Fisher was formerly worst enemy when it was abundant. Protected by law in some states.

Order Lagomorpha

Family Ochotonidae

Pika, Cony, Little Chief Hare

Ochotona princeps

Length to 8 in. Weight to $6\frac{1}{2}$ oz. Legs short and all about same length with soles of feet padded. No tail shows externally. Ears large but short, rounded, and white-bordered. Fur brown on back but yellow toward head and blacker on back. Feet white. Rarely seem to be fat even at end of summer season. Teeth: $I \frac{2}{1}, C \frac{0}{0}, P \frac{3}{2}$

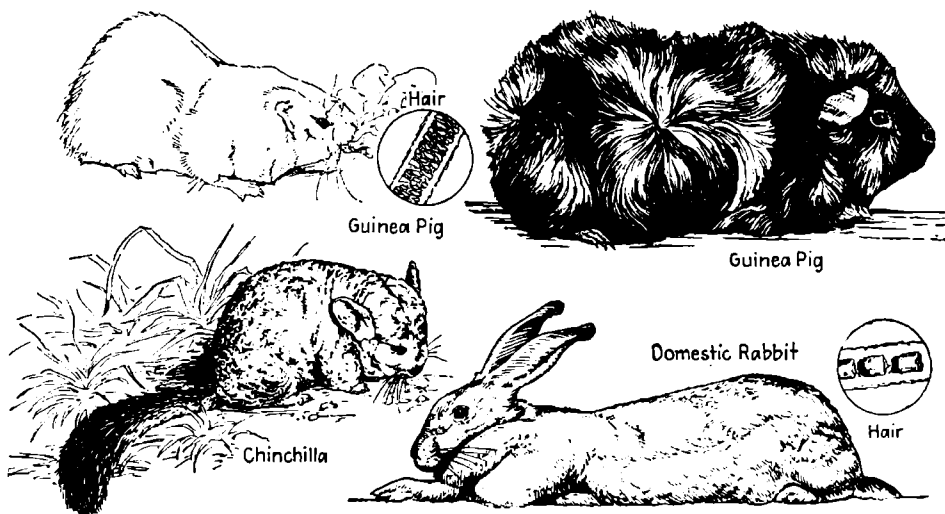
$M \frac{3}{3}$

Allied to rabbits although they may look like rats. Range through northern Rocky Mountains with allied species in Colorado, northern California, and Alaska. Old World pikas are abundant in Asiatic mountains, usually at elevations of 3,000-12,000 ft. Common name "cony" also applied to hyrax, an ungulate only remotely related.

Usually 3-4 $\frac{1}{4}$ -oz. young to a litter, usually born May-September in comfortable grass-lined nest protected by parent. Family apparently is cooperative. One pika has been known to relieve another being chased by a weasel though whether this was a relative or not is not known.

Food, plant materials stored for winter use in a stack to nearly a peck in size, guarded over by a pika that watches near by on a large rock and gives a squeaking song that apparently is understood by others of the neighborhood. Plant food includes leaves, stems, and roots, usually dried. Mostly nocturnal.

Pikas probably have no value to man except that they are basic food for some animals whose pelts have value as fur. They may compete with sheep and other grazing domestic animals that feed at high elevations, but food they harvest and store is still available for eating by the domestic animal. Fur durability, 20% that of otter.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Rodentia

Family Chinchillidae

Chinchilla

Chinchilla lanigera

Length, body 9 in., tail 5 in. Shape and behavior, squirrel-like. Head rabbit-like, except for shape of ears which are broad, rounded at tip, and nearly as long as head. Eyes large and black. Mustaches long and white or black. Skin thin but strong. Hair fine, making thick gray pelt, ashy beneath.

Native of higher Andes, from south of Chile to north of Bolivia. Practically vanished from original range but now successfully domesticated in United States. Short-tailed chinchilla is larger than common chinchilla.

Strictly monogamous. Mates for life, bears first litter of 1-4 young 111 days after breeding. Young fully furred, open-eyed at birth, able to run within an hour; nursed 45 days but stay under care of both parents at least 75 days. In captivity, courts and mates at 5-8 months, bearing 1-3 litters annually. Lives 8-10 years.

In captivity eats yeast, molasses, wheat germ, oat middlings, peanut oil, soybean oil, alfalfa meal, and bone meal, with carrots thrice weekly and orange juice twice weekly. Daily ration about 2 oz. A ground animal, unable to climb but runs and hides rapidly. Nest clean and bare. Affectionate, clean, nocturnal.

Probably most valuable fur bearer; a coat of pelts brings \$20,000-\$100,000. Breeding animals in 1939 worth \$3,200 a pair. Breeders introduced into United States in 1923 by M. F. Chapman, who started with 18 animals. 16 years later, there were 29 chinchilla farms scattered across continent. 120-140 pelts needed per coat.

Family Caviidae

Guinea Pig

Cavia cobaya

Length about 10 in. Weight about 1 lb. Body stout and heavy. Legs and tail short. Front feet 4-toed. Hind feet 3-5-toed, with large angular nails. Fur of wild animal coarse, long, and grayish-brown; of domestic animal, highly variable. When hungry, gives a grunt like a pig.

Some 20 wild species and many more domesticated varieties. Varieties are named English, Peruvian, Angora, and Abyssinian, but parent stock undoubtedly came from South America, the name "guinea" being a corruption of Guiana. In Brazil, are known as "cavies"; said to have been brought to Europe by Dutch in sixteenth century.

Although wild guinea pigs breed only twice a year, domesticated animals may breed every 2 months after maturity and mature in 3-5 months after birth. Young born 61-63 days after breeding; eyes open; hair fully developed; run a few hours after birth. Litters of 4-12, though in wild animal, only 1-2. Life span 8 years.

Lives on vegetation in wild, usually feeding when sunlight is dull. Never bites. Has unpleasant odor but makes excellent gentle pet. Cannot stand low temperatures. Young independent of mother at 3 weeks. Wild animals burrow in sand or prefer living in vegetation-covered marshy areas. Respiration, 100-150. Temperature, 101.7-102.6°F.

Domesticated and raised for food by Incas of Peru before advent of white man to America. Now bred for studies in heredity, for production of serums in medicine, for isolation and production of disease-producing organisms, and for pets. Greatest importance unquestionably is in connection with medical research. Popular with pet fanciers.

Order Lagomorpha

Family Leporidae

Domestic Rabbit

Lepus cuniculus

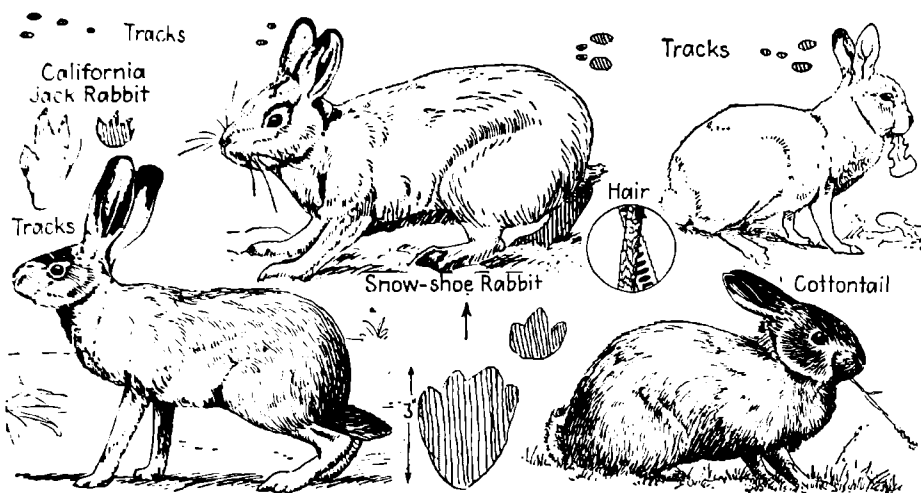
Wild European rabbit, from which domestic rabbit is developed, weighs 7-12 lb. Dutch rabbits may weigh as little as 1½ lb. While wild rabbit has erect ears, domestic forms with lop ears 23 in. long are developed. Forefeet with 5 toes, hind feet with 4. Teeth: $I \frac{2}{1}, C \frac{0}{0}, P \frac{3}{2}, M \frac{3}{3}$

Belgian hare is a true rabbit, while showshoe rabbit is a true hare; former bears helpless, naked young while latter does not. Probably no mammal except dog has developed more variation under domestication than the rabbit. Found domesticated and raised for food and pelt in all parts of civilized world.

After male *buck* breeds with female *doe*, young are born in from 30-32 days, in litters of 4-12 or more. Young remain blind for a number of days and are cared for splendidly by mother but not by father. May be 6-8 litters a year but average 3½ a year, and families may stay together with other families indefinitely. Pulse, 140-160. Respiration, 55. Temperature, 101.7-102.5°F.

Easily cared for if given dry quarters where water, a place to burrow, and an abundance of food are provided. Generally feed at night or when light is not strong. Individuals may warn each other of danger by thumping on ground with hind feet. Hares do not normally care for young as well as do rabbits.

Bred for hair, flesh, genetic studies, hides, and pleasure. Angoras have hair 7 in. long, while silver grays have short, thick, chinchilla-like fur. Cheaper fur coats, "lapins" are rabbit; though durability is low, they are worth their cost. Trade names are arctic seal, clipped seal, polar seal. Some are excellent flesh producers; others serve in medicine. Fur durability, 5%.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Lagomorpha. Family Leporidae. HARES AND RABBITS

Jack Rabbit
Lepus californicus

Length to 2 ft., with 4-in. tail. Hind feet 5½ in. long. Weight to nearly 6 lb. Female with well-developed fluff of long soft hair on belly. Color dark brown, with white patches on forehead, around eyes, and on back of ears. Top of tail and tips of back of ears black. Paler in summer. Young like adults.

Animal of open plains, with many close relatives. Black-tailed jack, *L. californicus*, found from Nebraska and Texas to California and Washington. White-tailed jack, *L. campestris*, gray in summer and white in winter, in northern and western states from western Wisconsin to California and New Mexico, north to Saskatchewan and Manitoba.

Probably polygamous, breeding in warmer months. 1-5 young born 30 days after breeding, well developed, with eyes open, well-furred, weigh 2-3 oz.; ears short, begin to lengthen at 10 days. Kept by mother in individual and separate spots; nursed a few days. Possibly 2 litters in South, 1 in North.

Strictly a plant eater. Adult does not dig burrow or have home other than an area. May enter burrows to escape. Rarely social. Rarely drinks, water being formed from food. Speeding blacktail may jump 25 ft., leaving tail mark on snow. Speed, to 45 m.p.h. All carnivores are enemies, particularly man. 10-70 per sq. mi. in Minnesota. Tracks: F 1½ × 1½; H 2 × 3½.

Provides food for carnivores, acting as a buffer species between them and livestock but also competes with all grazing animals. Controlled by great drives, 1 sq. mi. sometimes yielding 8,000 jack rabbits. Has many parasites and carries tularemia, which may be fatal to men who handle the bodies.

Snowshoe Rabbit, Varying Hare
Lepus americanus

Length 18 in., tail 2 in. Hind feet 5½ in. Weight to 5¼ lb.; average 4¼ lb. In summer, red-brown above, black-peppered, with light brown on legs and pure white beneath. Top of tail dark-gray to black. Ears black-tipped behind and white-bordered in front. In winter, pure white except for black ear tips.

Some dozen races from mountainous West Virginia northeast to Rhode Island, along coast to Hudson Bay, west to Alaska except in extreme north, south to Oregon except coast of British Columbia, southeast to Colorado, north to Saskatchewan, and southeast through northern United States to West Virginia. Favors marshy woods.

Counting male fights others with teeth; indifferent to 1-6 young born 36 days after breeding. 1-3 litters, April-August. Young, fourth hour, sound-sensitive, 3 oz.; first day, gray fur, run instead of hopping; second day, crawl; third day, hop; fifth day, raise ears; seventh day, 4½ oz., on all toes; eleventh day, ½ lb., nibble hay; twenty-first day, fight, 14 oz. 33 days old, 1¾ lb.; thirty-fifth day, nursing stops, 1½ lb. Average daily gain for 159 days from birth, about ½ oz.

Food: favors aspen, conifers, and dandelions; in summer, raspberry tangles. Female defends territory when bearing young, 10 acres per rabbit, but 5-6 per acre not uncommon. Drinks freely. Abundance cycle, about 10 years.

Must have room. No nest, but rests in forms. Enters burrows for safety. Does little damage to forests because of eating here and there; may "top" young conifers. Abundance varies in definite cycles with lynx and other predators. Good game species. May eat dead of own kind. Fur of little value, known as Baltic fox or white fox in trade. Important to northern natives.

Cottontail Rabbit
Sylvilagus floridanus

Length to 15 in., tail 2 in., fluffy. Weight 2½-3 lb. Ears long. Hind legs long and powerful, do not bring good luck. Dark-brown above, mixed with gray. Top of tail brown. Under part of tail and all under parts white. Sexes and young colored similarly except that young are more yellowish-brown and have shorter ears. Teeth:

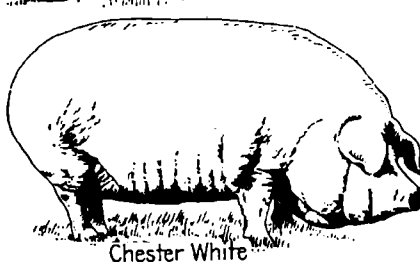
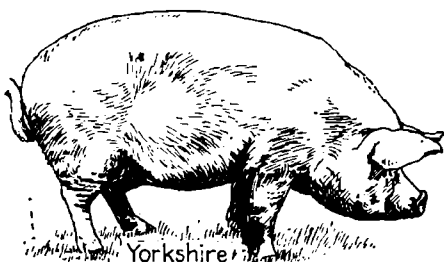
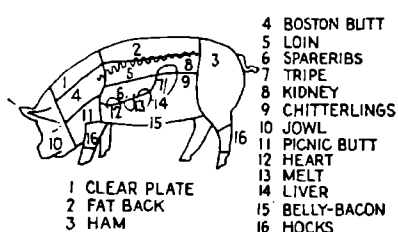
$$I \frac{2}{1}, C \frac{0}{0}, P \frac{3}{2}, M \frac{3}{3}$$

S. floridanus, found in United States east of Dakotas, Colorado, and central Texas; *S. nuttalli*, through Rocky Mountain areas border to border; *S. auduboni*, in Rocky Mountains, central and southern California and southwest; *S. bachmani*, on Pacific Coast; *S. palustris*, in Gulf States and eastern Virginia, south. Town or country.

Promiscuous in mating. Breeds several times a year; probably 4 times in warmer regions. 4-7 young, ¾ oz., born 30 days after breeding; hidden in hollowed fur-lined "form" among vegetation; tiny, naked, helpless; each about 4 in. long; by 2 weeks, run from nest; may nurse about 2 weeks. Mother makes nest and protects young. Life span to 8 years.

Food, a variety of plants including herbs, tree bark, and vegetables but not commonly fungi. Varies in numbers through years. Sheds fur May-June, again September-October. Breeding activity, indicated by abundance on highways, shows male active earlier and later through year than female. Tracks: F 1 × 1; H 1½ × 3½; Sp 5; L 84.

Pest as crop and tree destroyer. Appeals to hunters for flesh and sport but carries tularemia, which may be fatal to man. Fur used in manufacture of felt hats. Durability of fur, 5% that of otter; trade name, electric seal. Flesh worth about 25 cents in markets. Animals not profitably raised in captivity. Valuable to sportsman more a pest to farmer.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Artiodactyla. Family Suidae. SWINE

Yorkshire Hog *Sus scrofa*

One of largest of all breeds of swine. White, long, narrow, deep-bodied, usually without wrinkles. Ears erect. Head short, well-dished. Side long, deep, and smooth as would be expected of bacon type. Small Yorkshires raised largely in Europe are of the lard type, while American breed is bacon type.

Developed in county of York, England, by factory workers rather than by farmers; raised to furnish pork for home consumption. Breed known for over a century although it has been modified from long-legged animal into fine-quality bacon beast. Does well in close quarters. Introduced into United States in 1841; into Canada in 1886.

Berkshire Hog *Sus scrofa*

Medium-sized hog. Rarely exceeds 900 lb. in weight. Bred for long body, of good depth and medium width; for fine-quality meat, with high proportion of lean to fat. Snout short and up-turned. Ears erect. Black with white markings. Not hardy and lacks rustling ability.

Developed originally in south of England, particularly in counties of Berks and Wilts from crossing original English hogs with Chinese and Siamese hogs, thus improving quality of meat. Other later changes produced less coarseness and small ears in place of large flopping ears. Breed introduced into United States in 1823.

Chester White Pig *Sus scrofa*

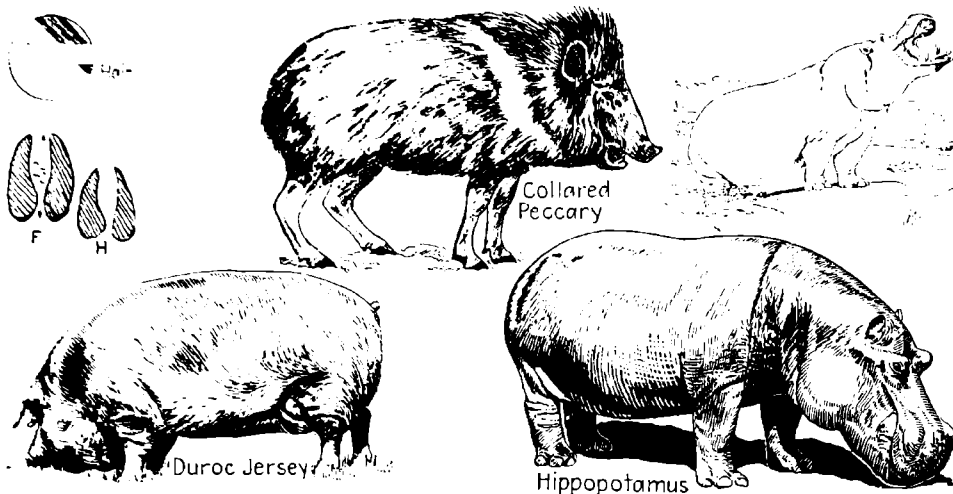
A popular pork-type pig, developed for large size. Breed to have head of medium length. Face straight. Ears forward-pointing and breaking $\frac{3}{4}$ - $\frac{1}{2}$ from outer tip. Legs strong and of medium length. Show animals should have no black.

Began in counties of Chester and Delaware near Philadelphia, from white hogs brought there in 1820. Swine with Chinese strains were bred to Chester County Whites. Mothers of this breed are excellent, bringing large litters to maturity and large size quickly, on a minimum of food and with little care before slaughtering time.

Swine just born are *pigs*; when weaned, they are *shoats*. Young female is a *gilt*; mature female, a *sow*. Mature males are *boars*; emasculated males incapable of reproduction are *barrows*. Sows should be 1 year old before they are allowed to produce their first litter but may breed at 4 months. Young born about 112 days after breeding. If care is shown with sows of prolific breeds, 2 litters a year may be produced. Sow in heat for 2-4 days every 3 months unless mated. Breeds and individual females vary in their ability to bring litters through to maturity. Young pigs ordinarily run with mother 10-12 weeks, but if 2 litters are to be raised they should be weaned at 8 weeks, being allowed to return to sow only to relieve udders temporarily. Sows can breed well for 6 years. Cleanliness pays in rearing young pigs. Pulse, 70-80. Respiration, 8-18. Temperature, 101-103.5°F.

Success in pig raising depends on understanding and meeting food requirements. Pigs grow more rapidly than cattle, reproduce earlier, and eat less roughage. Proteins such as grain, skimmed milk, whey, and good pasturage are essential. Need 8½ gal. of water daily. Growing pigs need mineral matter such as salt and alfalfa hay. Brood sows must in addition have ample exercise and freedom from parasites, for which good pasturage is again good treatment. In winter, sows may be fed corn with alfalfa hay and properly fed, they may reach 300-400 lb. in 1 year. Boar should not be allowed to become too fat and pasturage in summer with about 1 lb. of grain a day should be suitable. A sow with a new litter should have only warm water for first day; then warm thin foods for 4-5 days. Fattening of pigs is a science, varying in Corn Belt and pasturage areas according to food available. Each area has its own problem, generally solved by local agricultural college.

In 1938, United States pig population was 44,418,000, worth about 500 million dollars. World Almanac or agricultural year-books will show how these figures vary from year to year, but any animal worth ½ billion dollars is bound to influence the prosperity of many people. Breed popularity is Durocs first, Polands second, and Berkshires third, particularly in Corn Belt area. Chester Whites probably rank about fifth, but these rankings mean nothing unless one knows the purpose for which they are made. Yorkshires are relatively few in numbers, yet produce highest quality bacon and in that category rank next Berkshires. Swine are probably older on earth than man, probably equal to age of horses or about 3-6 million years old. They have been domesticated since 2900 B.C. in China, but much later than that, from wild swine, in Europe.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla

Family Suidae

Duroc-Jersey Swine
Sus scrofa

Large red rather long-legged pig with heavy bones. Some breeders reject animal with heavy hams, short legs, heavy jowls, and thick heavy form. Only other conspicuously red pig raised in America commonly is the Tamworth, a bacon type, while the Duroc-Jersey is more of the pork type.

Developed in United States through crossing Durocs which had been bred in New York State with Jerseys developed in New Jersey. Earliest record is 1832; until 1875, they were commonest breed in New York, Vermont, and Connecticut; after that, they became popular breed of Middle West where they developed a superior hog.

Pigs have 6 incisors on either jaw, outer pairs present at birth; center pairs appear at 3 months and remaining pairs at 4 months. At 6-10 months, outer pair are replaced by permanents; at 20-24 months, intermediates; and at 30-36 months middles.

Has excellent grazing ability and so is popular in Corn Belt states where suitable food is easily available. Hardy quality of this breed makes it possible for them to be reared in great numbers where housing facilities are limited or relatively poor.

This breed is more popular in United States and Canada than elsewhere, being probably even ahead of the Poland China breed, which is ordinarily reared for the same qualities. In Canada, where there are relatively few Duroc-Jerseys, the breed is most popular in southwestern Ontario and Alberta.

Family Dicotylidae

Collared Peccary
Dicotyles torquatus

Length 38 in. Height to 16 in. at shoulder. Weight 46 lb. Color blackish-brown with yellow-brown mixed with white on flanks. A broad whitish stripe runs from shoulders down to chest, like a collar. A large gland on back that looks like a navel; lacking in domestic pigs. Hind toes, 3. Teeth:

$$I \frac{2}{3} \quad C \frac{1}{1} \quad P \frac{3}{3} \quad M \frac{3}{3}$$

Originally ranged from Arkansas and Texas to Patagonia. Now in United States found chiefly in southern Texas, southern Arizona, and part of New Mexico, preferably in marshy forested lands where soil is easily explored with snout; also found in cultivated lands and nut groves.

Probably polygamous, though this is disputed. Breeds at any time, 1-2 young being born 112-116 days later. Young well-haired when born, spotted or striped; in 2-3 days, follow mother; in 1 month, join herd of adults in spite of small size. Young usually born in a cave or hollow log.

Food, a variety of roots, fruits, leaves, insects, reptiles, and almost any living plant or small animal which happens to be in way, though nuts, grain, and vegetables are favored when they can be had. Goes in herds and has been reputed to be vicious. Can defend itself well against dogs. Speed, 11 m.p.h.

An interesting game animal, practically exterminated from United States territory. Destructive to crops at times but also destructive to many injurious animals. Flesh has value as food to man and hide has some value. 80,000 shipped in from Mexico each year. Known to kill rattlesnakes and in herds can drive off jaguars and other foes.

Family Hippopotamidae

Hippopotamus
Hippopotamus amphibius

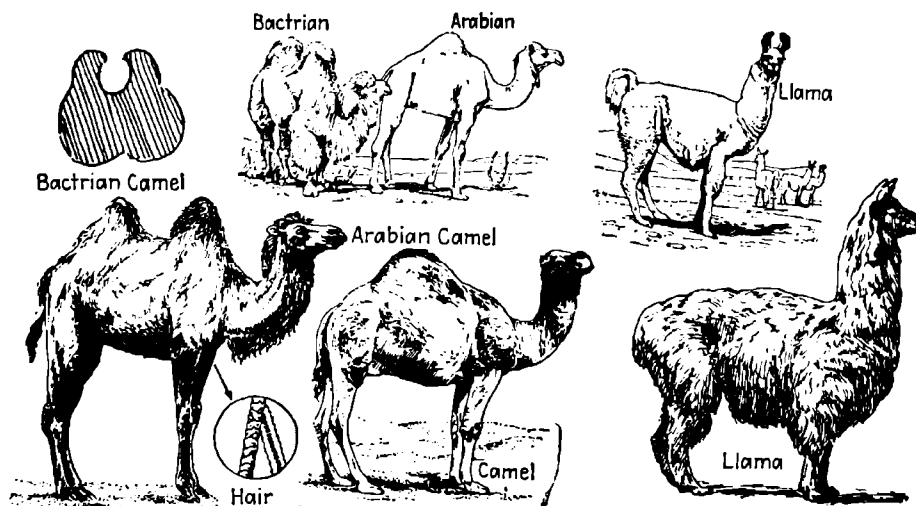
Length nose tip to tail tip, 14-17 ft. Girth about same. Male larger and darker than female. To 8,000 lb. Mouth possibly 2 ft. wide, with large tusks. Eyes set high and far back, just in front of ears, which are 3-4 in. long. Nostrils, large, at top of blunt nose. Shoulder height to 5 ft. Canine teeth with 9¾-in. circumference.

Never far from water, most of time being spent in rivers, shallow mud-bottomed lakes, and lagoons; formerly from Egypt to Cape of Good Hope but now restricted to river area south of 17°N.L. Related and, of course, smaller pygmy hippopotamus is restricted to west coast of Africa.

Single young born 234-243 days after breeding; walks 5 minutes after birth; 18 in. high and 3 ft. long; weight 60 lb., gray and wrinkled; at 9 months eats solid food; at 18 months, male weighs 600 lb., female 650 lb. First young born when female is 7½ years old. Life span about 35 years.

Food, all sorts of succulent water plants, but also eats such crops as corn, sugar cane, and millet. In zoos, eats mixture of rolled oats, bran, cabbage, potatoes, lettuce, bread, and hay. Cannot remain submerged more than 5 minutes. Apparently enjoy each other's company, as they appear in large herds where undisturbed.

May do considerable damage to crops. Flesh is edible and is used as food by natives. Hide makes an excellent soup, much like turtle soup. One animal may yield 200 lb. of fat, prized by Arabs. Teeth make excellent ivory. Probably the behemoth of Old Testament.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Camelidae. CAMELS

Bactrian Camel
Camelus bactrianus

Shorter legged and therefore not so tall as Arabian camel, but with a heavier body and 2 humps on back instead of 1. It has a heavier coat of hair, and harder and shorter feet, which enable it to travel over rougher country more easily than the Arabian camel. It is more docile and easier to ride, but slower.

There are probably no wild Bactrian camels except those which have escaped from domestication. Now confined to deserts of central Asia though a native of steppes of eastern Asia. It is to the wandering Mongolian tribes of Gobi desert that Arabian camel is to Arabs. Never needs shelter in bitterest weather or hardest traveling.

Life history is essentially that of Arabian camel. This species can begin to earn its own living by work at age of 4 and can continue a life of usefulness until it is 25, 30, or even older, which is probably longer than is possible with the Arabian camel.

Food, any plant material available, even bitter salt-marsh plants rejected by other animals. When forced by hunger, it will even eat fish, flesh, bones, and skins and will drink either salt or brackish water. Is able to uncover plants under snow and get them for food in winter. Can go 8 days without water in winter.

Probably most useful beast of burden in colder northern deserts, carrying daily loads of 500-600 lb. of coal, oil, or other goods over roughest of territory. It also yields hair, hide, flesh, and milk of direct use to man. Both species are figured in earlier Assyrian sculptures. Long used in war, even to present.

Arabian Camel, Dromedary
Camelus dromedarius

Height at shoulder to 7 ft. Legs and neck long. Feet 2 toed, soles being undivided and hoofs on upper surface. Hair soft and unevenly placed, longest being on head, neck, shoulders, hump, and thighs. Tail relatively short. Prominent pads on knees.

Arabian camel is used both in Africa and in central Asia. It has been introduced unsuccessfully in southwestern United States, in Australia, and in southern Europe, but still finds a place for itself in Africa and Asia. 2 attempts to introduce it in United States failed and it will probably not be tried again.

Single young born 45-56 weeks after breeding; calf goes to pasture when 1 day old, has a soft fleece, gives a gentle *bah*, lacks knee and breast pads of adults. Mothers mourn loss of young as much as 3 months. Young becomes full-grown at 5 years. Female may bear to 12 young during lifetime. Life span 17-50 years.

Food, all sorts of vegetable materials available. With 1 drink of 15 gal. of water, can carry 400-600 lb. 30 miles a day for 3-4 days without water, or 1,300 lb. 6-10 days for a shorter distance. 6 camels can draw as much as 3 6-mule teams over territory impassable to mules. Pulse, 30. Temperature, 99.5°F.

Most valuable desert animal for work, flesh, milk, hair, and other purposes. Has been domesticated for 5,000 years; appears on pottery of 4000 B.C., and bones have been associated with those of Neanderthal man.

Llama
Lama peruana

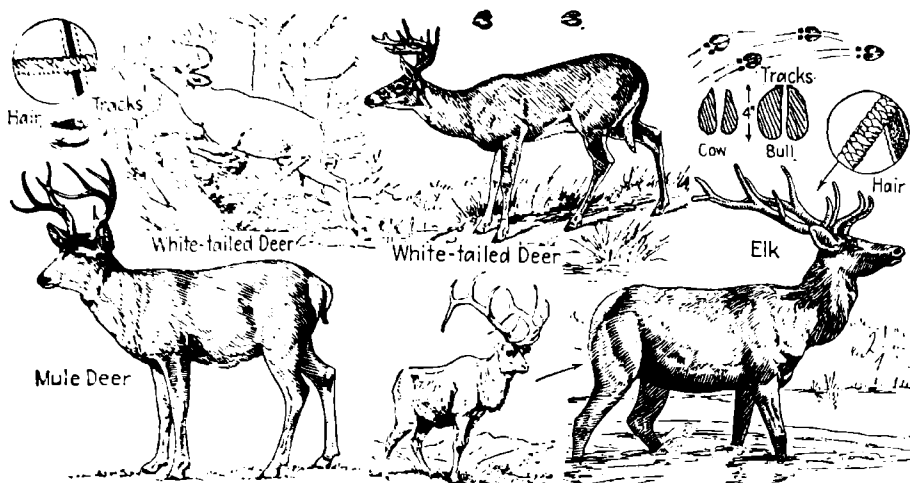
Length 4 ft., tail 3½ ft. Height 3 ft. at shoulder. Neck nearly 2 ft. long, with broad body and thin legs. Toenails, sharp talons. Hair thick, soft, and shorter on head and ears. Color commonly white or brown. Alpaca is larger, slightly longer haired, and has smaller head. Name pronounced "yama."

Both llama and alpaca are derived from wild guanaco. Llamas are found in Peru, Bolivia, and on west coast of South America. In temperate climates like cooler Patagonia they come down to sea but in equatorial regions are found in Andes at 12,000-16,000 ft. elevation. Guanaco still exists in wild state.

Breeds every 2 years, when young males are driven from herds by females while older males fight each other for leadership. Breeds in July; single young with conspicuously thin neck, body, and legs is born 11 months later. Llamas mate with alpacas but offspring are sterile. Life span 12-18 years.

Food, coarse vegetables including shrubs, mosses, lichens, and grasses. If succulent food is available, it does not drink. Lives in large herds. Is more intelligent than camel. Expels stomach contents in face of offenders. Generally gentle and may be ridden or driven by children. Must have cool climate to thrive.

Valuable for fleece, although male is used as beast of burden, carrying about 100 lb. Alpaca fleece superior, producing 11-15 lb. when sheared every other year. Flesh of young llama tender, of old, too tough for use except when dried. Efforts to establish llama in Australia and Europe have failed. 6-foot vicuña robe weighs less than 4 lb.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Cervidae. DEER

Mule Deer

Dama hemionus

Length to 6 ft., including 8-in. tail. Shoulder height to 42 in. Weight to 450 lb.; doe smaller, with average length of 4 ft. In winter, brownish-gray with black above; throat, inside legs, patch on buttocks, and face white; tail white except for black bunch on tip. May–August, red replaces brownish-gray. Female duller. Fawn yellowish with white spots. Teeth: $I \frac{0}{4}, C \frac{0}{0}, P \frac{3}{3}, M \frac{3}{3}$

Coast blacktail, *D. columbianus*, has bushy tail, all black above; mule deer, a black-tipped not bushy tail; and whitetail, black only in center of top of tail. Mule deer ranges from central Mexico north through Manitoba and west to Coast, except in northwest California and western Washington, Oregon, and British Columbia where blacktail is.

Breeds in November; buck wins harem of does. 1–3 fawns born May–June; kept hidden 6–8 weeks; nursed by doe; fawns follow doe during summer and first winter; young does may follow her for 2 years. Young whitetail may bear young at 2 years, and mule deer probably does the same. Life span about 7 years.

Food largely twigs and brush; while grass is eaten, it is not favored. Gets along well without water except for that obtained from succulent plants. Eats moss but favors nuts, acorns, and evergreen oak. Horns do not face forward as in whitetail. Gland on inside of leg long, rather than small and round. Tracks: F $2\frac{1}{2} \times 3$, 2; H $2\frac{3}{4} \times 2\frac{3}{4}$, 2.

Valuable food and sport animal naturally kept in control by coyotes, bear, and cougar but also by sportsmen. Serves as attraction to tourists in recreation areas. Becomes tame enough to feed out of hand. Horns shed in February, blacktail often earlier than mule deer.

White-tailed Deer

Dama virginianus

Length to 8 ft. Tail 11 in. Height at shoulder to 4 ft. Weight to 300 lb. Reddish-chestnut or gray above with white below. Bucks with forward-pointing antlers to 30 in. long, but with prongs upward-pointing. Marvelous jumper and runner. Does, smaller. Fawns, spotted. Teeth: $I \frac{0}{4}, C \frac{0}{0}, P \frac{3}{3}, M \frac{3}{3}$. Tracks: F $2 \times 3\frac{1}{2}$, 2; H 2×3 , 2.

Through North America south of Gulf of St. Lawrence and James Bay, west to Rocky Mountains; including 9 closely related species, range is extended north-west to south of Columbia River in Oregon. Thrives around clearings, in mixed woodlands, with water near by and plenty of food. Individual range rarely over 1 sq. mi.

1 male forms a herd with 2–3 females, fighting rival bucks; breeds in November; 1–4 fawns born $6\frac{1}{2}$ –9 months later (June), each weighing at birth about $3\frac{3}{4}$ lb. Young hidden and nursed every 4 hours; by 4–5 weeks, follow mother; weaned and lose spotted coat at 4 months. Doe may follow mother 2 years or breed first year; buck follows mother 1 year.

Food largely browse, such as twigs and leaves of trees, not common grass. Will eat rye grasses, prefers weeds to timothy or bluegrass and particularly enjoys nuts, yellow water lily, and acorns. In winter may form "yard" of a herd in snow, keeping snow trampled; often starves. Speed 30 m.p.h. Jump 8 ft. high, 30 ft. horizontal.

A most valuable game animal providing sport, flesh, hide, and trophies of high grade. In Texas, farmers receive to \$100 for deer harvested on their farms. In most states, sportsmen prevent similar enlightened provisions with result that they get deer and farmers get nothing but injured crops. About 300,000 killed annually in East. Destructive to orchards.

Wapiti, Elk

Cervus canadensis

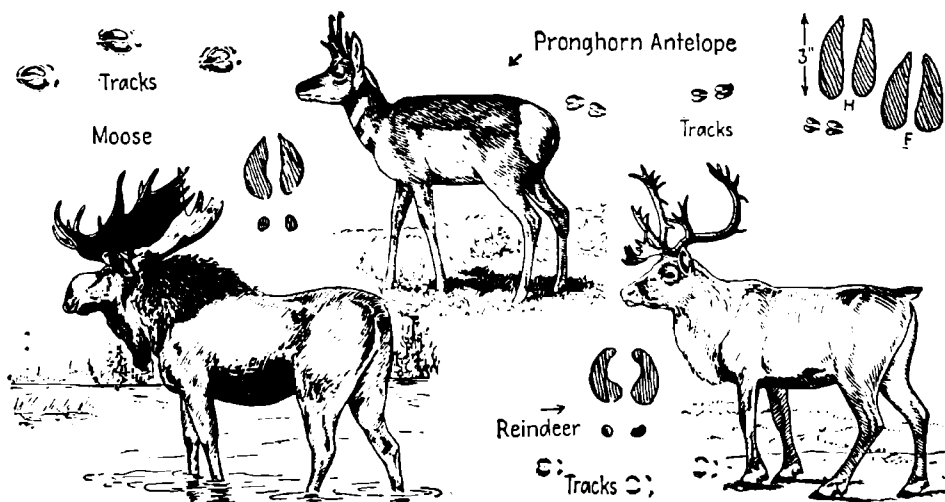
Length to 9 ft. Height at shoulder to 5 ft. 8 in. Girth around chest, 6 ft. 8 in. Weight possibly to 1,000 lb. but averages male, 700 lb.; female, 500 lb. Buck with great head of horns to 5 ft. long which are shed each year. Gray-brown but darker or chestnut along back and mane; lighter beneath rump patch. Cow paler. Teeth: $I \frac{0}{4}, C \frac{1}{0}, P \frac{3}{3}, M \frac{3}{3}$. Tracks: F $3\frac{1}{2} \times 4\frac{1}{2}$, 2; H $3\frac{3}{4} \times 4$, 2.

Found from New Mexico and Arizona to British Columbia, formerly east to Atlantic; now eastern representatives are limited to parks or to eastern Canada but no great numbers anywhere outside an area along Rockies from Colorado to central Alberta. Last Pennsylvania elk was killed in 1869. One killed in New York in 1946. Reduction of range is inexcusable.

Bull fights in November, wins harem of cows. 1 calf born 249 to 262 days after breeding, weighs $30\frac{1}{2}$ lb. at birth; has spotted coat; follows cow in 3–4 days; grazes in 4–6 weeks; weaned in October, loses spotted coat; follows cow another 6 months. Cow breeds first at 3–4 years. Life span 18 years. Jumps to 10 ft. high.

A grazing and browsing animal, which means that through year it may move from one area to another, winter and summer range being different. Sanctuaries for elk to be effective must provide year-round feeding areas under protection. Antlers are shed each spring, around March, and new ones immediately begin to grow. Can increase 33% in 10 years.

Superior game animals which, in earlier times, provided food, hides, and bones for humans. Wapiti have been slaughtered by thousands for no other purpose than to procure elk teeth (2 to an animal) for watch charms for a fraternal order, carcasses being left to rot.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla

Family Cervidae

Family Antilocapridae

Moose

Alces americana

Length to 9 ft., with 3-in. tail. Height 7 ft. at withers. Antler spread to 6 ft. Weight probably to 1,800 lb. Cow about $\frac{3}{4}$ size of bull, without antlers. Muzzle broad. Snout blunt. Shoulders higher than rump. Forequarters heavier. Hoofs long and pointed. Blackish-brown, but lighter in summer.

Teeth: I $\frac{0}{4}$, C $\frac{0}{0}$, P $\frac{3}{3}$, M $\frac{3}{3}$. Tracks: F $5 \times 7, 2$; H $5 \times 7, 2$.

Found in wooded areas from New Brunswick and Nova Scotia across central Canada and southern Alaska, with some found along Rockies as far south as Wyoming; seen commonly in Yellowstone Park; also south in United States in northern North Dakota, Isle Royale, and northern Maine. Has disappeared from New York.

Probably polygamous but less so than most deer. 1-3 (?) calves born in May, 242-246 days after breeding; not spotted, dull red-brown; by 10 days run with mother; stand 3 feet. With mother 2 years (?). Cow receptive to bull for 30 days; bull in breeding mood 6 weeks. Cow does calling; bull bellows; breeds second year. Life span to 20 years.

Food, browse from woody plants, particularly hardwoods; favors succulent water plants, such as yellow water lily. Family of a bull, a cow, and some calves stays together through winter, "yarding" to keep high snows down. May not move outside a 10-mile range in lifetime. Trots through brush at 15 m.p.h.

Superior game animal which has been destroyed over much of its range and reduced elsewhere. Provided food, leather, and bone for earlier peoples and improves the wildness of an area now. Should not be further reduced in numbers.

Caribou, Reindeer

Rangifer caribou

Length 6 ft., tail 4 in. Height at shoulder 4 ft. Weight to 300 lb. Cow smaller, weighing about 150-250 lb. Both sexes bear horns, unlike most other deer; colored alike, brown with yellow-white on neck, lighter in winter. Barren ground caribou, *R. arcticus*, smaller. Teeth: I $\frac{0}{4}$, C $\frac{1}{0}$, P $\frac{3}{3}$, M $\frac{3}{3}$.

Woodland caribou, *R. caribou*, New World reindeer, originally ranged from northern Maine to Minnesota and to northern Alberta, south to Idaho, northwest to Alaska except close to Pacific Coast north through Alaska and Canada to tree belt, with close relatives on to land limits. *R. arcticus* is Old World reindeer.

Polygamous, breeds in October; bulls fight for many mates. Rut about 2 weeks. Male loses horns in early winter but doe does not. 1-2 young born 7 months, 7 days after breeding, or in May; walks in 2 hours; suckled 2 months; then in fall joins herd which may migrate to new area. Doe sheds horns in spring. Life span to 15 years.

Has strange migrations every 3-4 years and is probably more of a roamer than other deer here considered. Has strong-scented neck glands. Swims at 5 m.p.h. and runs at 10 m.p.h. but can travel 100 miles in a day. Feeds largely on available plants such as grasses, lichens, and mosses.

One of most useful deer, since it and its kin are domesticated, yielding flesh, milk, hide, and bones and being able to draw a 250-lb. load over snow 1 mile in 3 minutes. Will probably be flesh producer of North; may be sold in markets of future to supplement domestic animals of warmer regions.

Pronghorn Antelope

Antilocarpa americana

Length to over 4 ft., with 3-in. tail. Height at shoulder 3 ft.; to top of head, 4 ft. Weight of buck 125 lb.; of doe, 90 lb. Horns to 20 in. long, hollow on a bony core like goats, but branched and shed each October like deer; also, 4 teats and woolly underhair like deer. Each foot with 2 hoofs. Color tan and white, bucks darker. Teeth: I $\frac{0}{4}$

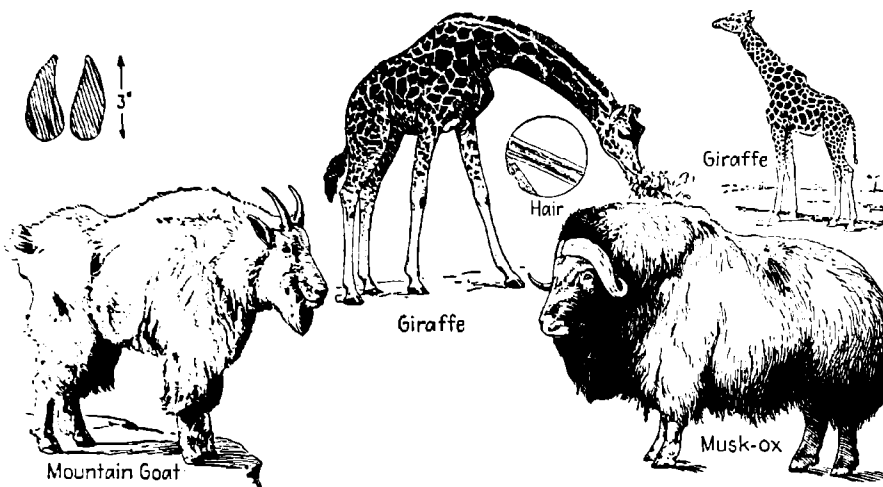
C $\frac{0}{0}$, P $\frac{3}{3}$, M $\frac{3}{3}$.

Found in open country from southern Alberta and Saskatchewan through western Dakotas, Nebraska, Kansas, and Texas into northern Mexico and west through Lower California, southeastern California, Nevada, southeastern Oregon, and southern Idaho. Individuals range over 2-3 sq. mi. Range and numbers have been greatly reduced.

Both sexes horned, does smaller. In early fall, bucks form harem of does won by fighting. 2-3 kids born in 8 months or June, scentless, able to walk; can outrun dog in 10 days. Mother alone defends young, who follow her at 3 weeks. In July, does and kids make small herds, joined in August by young bucks. Mature at 5 years; aged at 15.

Food, entirely vegetation. Herds and individuals, kept together by bucks or by family instinct, helped by flashing white rump which serves as danger and recognition signal. Escapes from enemies or fights. Speed to 50 (?) m.p.h.; can leap 5-ft. fence. In winter, migrates to suitable grazing area usually in herds. May travel 20 miles a day.

Beautiful animals, relatively harmless but competitors with grazing animals for forage. Flesh good. Numbers in former time estimated at 40 million; latest estimate of present numbers, 165,000. Worthy of more protection from hunters, at present their worst enemy. Enticed to range of guns by inordinate curiosity. Tracks: F 2×3 , 2 ; H 2×3 , 2 .



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla

Family Giraffidae

Family Bovidae

Giraffe

Girafa camelopardalis

Height to 19 ft. Head with short blunt straight horn-like structures. Female slightly smaller, more slender. Stiff mane on back of long neck. Feet large, heavy, with divided hoofs. Yellowish or whitish, with large more or less square black spots on body, neck, head, and upper parts of legs. Female duller than male.

Formerly over greater part of Africa; now found only in regions south of Sahara, in central and south Africa. Areas where they live are waterless at certain times of year. Has been bred successfully in captivity in zoos but needs greater areas where it may be protected.

Bull maintains a herd of cows. One young, born 15 months after breeding in March-April; is gentle and affectionate if caught and can be induced to eat. Normally, a captured calf refuses to eat and dies shortly. Life span apparently about 25 years.

Food, leaves of such plants as acacias and mimosas. To graze on ground, animal must spread its forelegs far apart. Drinks little if any water. Gait is unique trot and gallop with neck bent forward and tail raised over back. It can almost outrun a fast horse if it has a good start. Voiceless. Sleeps standing.

Valuable to desert people for hide and food. Flesh is eaten raw. The tendons are used for sewing leather and for strings for musical instruments. Giraffe is shown on ancient Egyptian monuments. Julius Caesar is reported to have been first to exhibit one in Rome.

Mountain Goat

Oreamnos americanus

Length $5\frac{1}{2}$ ft., including $6\frac{1}{2}$ -in. tail. Height at shoulder $3\frac{1}{2}$ ft. Horns to 1 ft. long, pointing backward. Weight to 276 lb. Color white. Hair long, relatively coarse. A characteristic beard. Sexes and young colored alike. Superior climbers and jumpers. Sure-footed at all times. Teeth: I $\frac{0}{4}$, C $\frac{0}{0}$

P $\frac{3}{3}$, M $\frac{3}{3}$

Some 5 species and subspecies range through Rocky Mountains and coast ranges from Alaska south to Montana and Idaho; limited in United States largely to sanctuaries of national parks. Ranges high in summer, low in winter. Individual range not necessarily great.

Probably monogamous, since male and female are seen together with kid through summer. Young born 6 months after breeding; can stand in 10 minutes; jumps in 30 minutes; nurses in 20 minutes; at 2 days stands $13\frac{1}{2}$ in. high and weighs about 7 lb. Mother will defend young to best of her ability.

Food, grasses and similar vegetable materials available in home range. Kids are subject to attack by eagles, wolves, foxes, and other preying creatures. Not found in large herds, usually only few more than family group living together. Fur molts in spring. Tracks: F $2\frac{3}{4} \times 2\frac{3}{4}$, 2; H $2\frac{3}{4} \times 2\frac{3}{4}$, 2.

Tremendously interesting residents of equally interesting type of country. Hide has some value and flesh is eaten but the animals should not be exterminated. May possibly carry certain diseases but are too uncommon and too widely separated from domestic stock to be serious menace. Need more protection.

Muskox

Ovibos moschatus

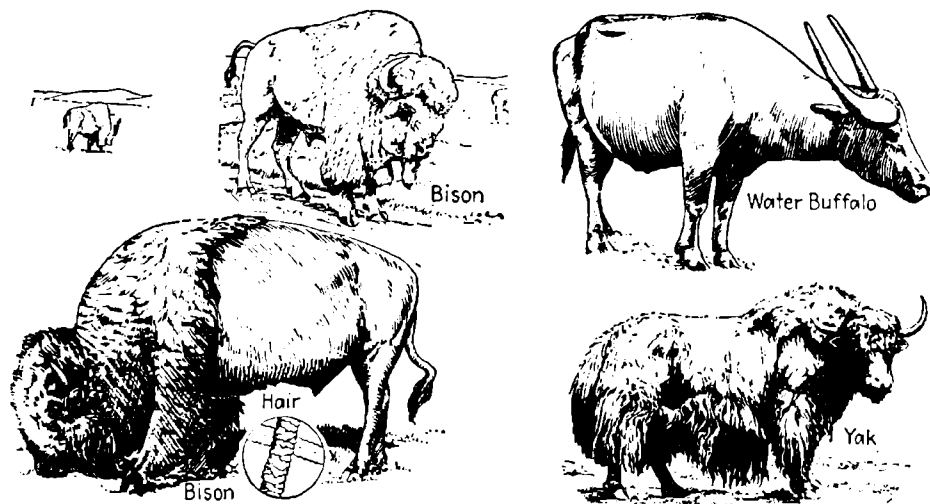
Length total, 8 ft., with 4-in. tail. Height at shoulder to 5 ft. Weight to about 700 lb. Deep brown on head and body to black on under parts in front. Legs dirty white. Saddle light brown. Sexes alike except that cow may be lighter than bull. Has a strong musky scent. Horn spread to 2 ft. Teeth: I $\frac{0}{4}$, C $\frac{0}{0}$, P $\frac{3}{3}$, M $\frac{3}{3}$

Fossil forms in Asia, Europe, and North America associated with Neanderthal and Cro-Magnon men. Now limited to northern Canada and Greenland, European and Siberian herds having been destroyed. Protection is afforded muskox in much area from which it has disappeared. It needs further protection or it will vanish.

Bulls fight, give off musk, and win herd of cows. Breeding in August produces 1 calf per cow in late May, which weighs 16 lb. at birth and stands 18 in. high; follows cow 1-2 hours after birth; a 4-day calf weighs 25 lb. and stands 20 in.; at 22 months, stands 3 ft. 2 in. Breeds in alternate years.

Food: favors grass and willows but will eat almost any vegetation available. When attacked by men or wolves, herd forms circle and fights to death. Has strong sense of smell but is normally not intelligent in defense; a whole herd will stand ground and be shot down rather than retreat if enemy stays in vicinity.

Provides easily attained and excellent source of food for natives. Zoo animal worth about \$1,600. Flesh edible but causes musky gases from eater. Bulletin, "The Present State of the Muskox," issued by American Committee for International Wildlife Protection in 1934, should be read by those interested.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Bison, Buffalo
Bison bison

Length to 11 ft., tail $1\frac{1}{2}$ ft. Height 6 ft. Weight to 3,100 lb. Color dark brown but lighter on rear portions. Hair over shoulders, forelegs, and head long and shaggy. Shoulders high-arched and powerful. Ears and eyes small. Horns short, sharp, curving upward, unbranched. Teeth: $I \frac{0}{4}, C \frac{0}{0}$

$P \frac{3}{3}, M \frac{3}{3}$

Formerly occupied territory between Appalachians and Rockies, south to Gulf of Mexico, north through plains of Canada with a related species, wood's buffalo, occupying territory to north. Now practically restricted to ranches and sanctuaries, though northern form is more abundant.

Possibly monogamous, though bulls fight each other. One calf born $9\frac{1}{2}$ months after August-September breeding, birth lasting less than 1 hour; calf stands in 3-4 days. Bull helps in protection. Calf with cow to 3 years, when young cow breeds; may bear 1 calf a year for 30 years.

Food, grasses and other ground forage, herds in the past moving north and south with seasons to get best pasturage. Small herds are family herds led by an old cow. Enjoys mud wallows as freedom from insect pests. Herds may be stampeded wildly in a given direction to their destruction. Speed, to 40 m.p.h.

Vanishing of buffalo herds is a disgrace to American intelligence, but saving them from complete extinction is a credit to a few far-seeing scientists. Bison provided Indians and early settlers with hair, hide, flesh, fuel, bones, and sport, all on hoof and easily obtainable anywhere.

Indian Buffalo
Bos bubalus

Length 9-10 ft., including 2-ft. tail. Shoulder height to 6 ft. Horns heavy at base and curving backward and inward to sharp tips with distance from tip to tip, along the curve, 8-12 ft. Horns flattened and strongly marked with cross wrinkles. Head longer, ears smaller than in Cape buffalo, which weighs to 4,000 lb.

Indian buffalo, *Bos bubalus*, wild in India, Philippines, Malay Peninsula, and Ceylon, loving water; widely used as domestic animal throughout Orient. Cape buffalo, *Bos caffer*, has horns shaped more like those of domestic cattle, though each may be 3 ft. long; found in east Africa from the Cape to Abyssinia.

Calves born 10 months after breeding, which takes place at any time of year. Cow yields great amount of rich milk, more in fact than some domestic cows. Both cows and bulls protect young, herd providing dangerous front to even such fierce animals as tigers which Indian buffalo apparently does not fear seriously.

Food, plant materials of ordinary forage type. Animal is attacked by great numbers of insects. As a protection, takes mud baths, caked mud preventing insects from reaching skin. Apparently buffalo has a keen sense of smell. It swims, dives, and feeds at night or in early morning, accepting rough forage.

Probably most useful domestic animal in Orient. Its hide makes excellent leather. While its flesh is inferior to that of domestic cattle, its milk is rich and makes liquid butter, *ghee*, favored in India. More powerful as a draft animal than ox, and more trustworthy than Cape buffalo.

Yak
Bos grunniens

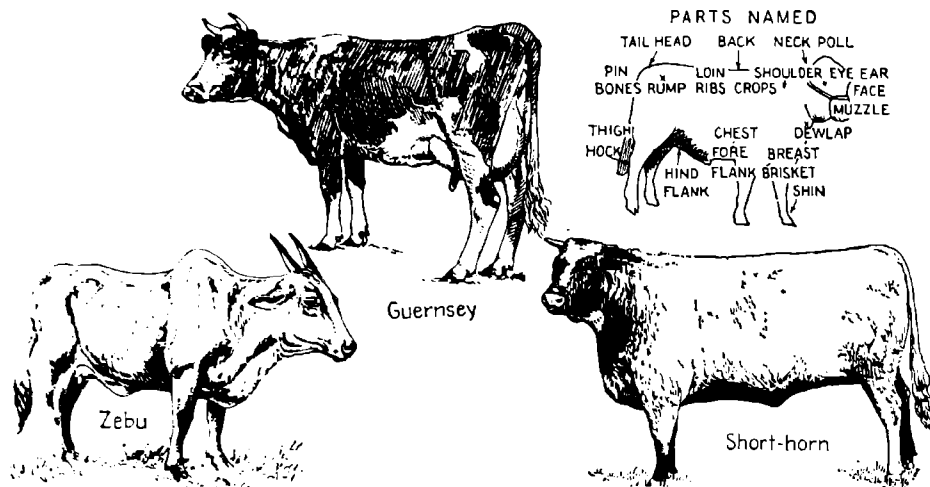
Larger than average domestic cattle and more solidly built. Legs short and stout. Shoulders high. Horns broad, upward-curving, unbranched. Most conspicuous of all is long hair growing like a fringe on tail, flanks, and legs, almost reaching ground. Prominent breast tuft of long hair. Blackish-brown.

Found in mountainous central Asia, particularly in Tibet region. Does well on barren soil which would not support similar large beasts. Cannot long survive warm regions. Domesticated yak is sometimes black, brown, red, or mottled instead of brownish-black of wild animal.

Reproduction probably similar to that of cattle. Calves born $8\frac{1}{2}$ -9 months after breeding takes place. Milk is exceptionally rich, butter excellent. Undisturbed, a yak seems like a lazy inoffensive animal, but cow will defend its calf valiantly.

Food, sparse grass available among rocks and crags where it lives. Feeds usually morning and evening, chewing cud between times. Sure-footed, making a good pack animal over difficult terrain, but it moves relatively slowly and cannot compete with a horse. It can charge quickly, even though wounded.

Used as a saddle animal, a pack animal, a source of hair for making cloth, and a source of meat, milk, butter, and cheese in territory which could not support ordinary domestic animals. Bladders are used for water bags and hide makes excellent leather. Tails are used as ornaments and as brushes in tropics.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Zebu, East Indian Ox
Bos indicus

Size varies from that of a small donkey to a large animal. Characterized by having large fatty lump, or sometimes 2, over withers and an excessively large dewlap, making neck huge. Color usually pale fawn, iron-gray, black, or bay, commonly darker forward. Ears long and pendulous.

In commoner African breeds, horns are usually large; in Indian breeds, they are small; sometimes, absent. Essentially creatures of warm climates, since they resist heat better than ordinary domestic cattle.

Reproduction similar to cattle. In United States, zebras were introduced in 1853 and again in 1906; now well-established in Gulf Coast states. Grade zebu bulls mated with domestic cattle produce tick-resistant, heat-resistant animals with better resistance than cattle and better flesh than zebras.

Food essentially same as that of cattle. Zebras are nervous, do not herd well, and can run rapidly, which makes them difficult to handle. Almost complete immunity of animal to ticks which cause Texas fever makes it popular in tick-infested country and to increase tick resistance in cross-bred animals.

Considered sacred animals by Hindus, who do not allow them to be killed. Serve as draft animals for work. Harnessed to carriage, they may travel 30 miles a day or, saddled, carry a man 6 m.p.h. for 15 hours. Carcass yields too large a proportion of cheap cuts to be popular with meat raisers. Domesticated by 4000 B.C.

Guernsey Cattle
Bos taurus

Dairy type of cattle, producing a quantity of good milk. Medium-sized. Color lemon or fawn, never gray or black. Nose buff. Switch and tongue generally white. Larger than Jersey cattle, the cow weighing about 1,000 lb. Skin yellow.

Developed on Island of Guernsey in English Channel off French coast. Island is 24 sq. mi. in size but has long maintained high standards of cattle breeding. Guernseys were first introduced into United States about 1831 but our present purebred herds are from subsequent importations.

Has 8 lower incisors. At birth, has middle pair; at 1 month, the next pair; at 18-24 months, permanent teeth replace first middle pair; at 27-36 months, next pair replaced; at 36-48 months, third pair replaced; at 45-60 months, the last pair.

Like other dairy cows, Guernseys require more water than do beef or dual-purpose types.

Guernseys are most popular in Wisconsin, which has about $\frac{1}{4}$ the herd; next in New York; then in Minnesota. One produced 24,008 lb. of milk with 1,098.18 lb. of butterfat a year; another, 1,103.28 lb. of butterfat a year.

Shorthorn Cattle
Bos taurus

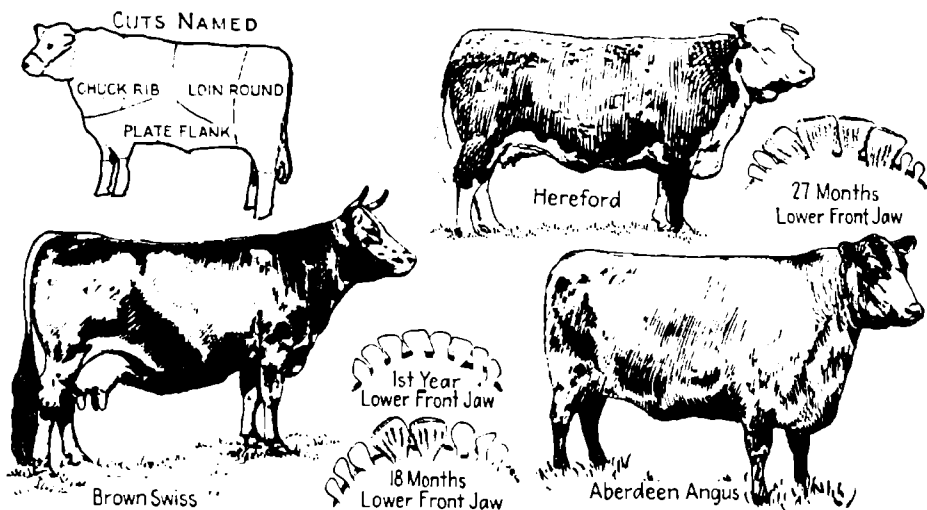
Dual-purpose cattle combining meat and milk production. May be red, red and white, or white and roan. Large, with broad back, deep body and mild disposition. Cow has good-sized udder. Varies in different places depending upon needs as draft animal or for beef or milk. In England, breed is considered a "double decker."

Developed in England, in counties of York and Durham, in valley of River Tees. Introduced into America as Durhams. In early nineteenth century, developed to put on flesh rapidly with heavy feeding and so competes with Herefords. Most popular in Middle West, West, England, Argentina, and Australia.

Variety known as "polled shorthorn" and as "polled Durham" is hornless and was developed in United States. In addition to hornless feature, it maintains good dual-purpose qualities of original breed. Shorthorns are particularly favored for improving ordinary stock.

Food similar to that of other cattle. Name shorthorn was used to contrast animal with traditional longhorn cattle of Southwest. Persists in spite of fact that Durham is a truer name for breed, particularly now that many shorthorns are hornless.

Shorthorns produce a high percentage of superior beef. Have been used as oxen for draft purposes because of weight, strength, and patience. Average milk production is 8,445 lb. of milk, with 333 lb. of butterfat. An Australian shorthorn has a record of 32,522 lb. of milk with 1,614 lb. of butterfat.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Brown Swiss Cattle
Bos taurus

Raised for dairy and beef properties. Mouse-colored, with nose, switch, tongue, and horn tips always black and a light stripe down back. Cow weighs 1,200–1,300 lb.; bull 1,700–1,900 lb.; calf at birth to 100 lb. Head large and coarse. Breed is slightly lighter than Holsteins. Calves usually strong.

Possibly oldest of present-day breeds; developed in Switzerland mountain pastures. Introduced into America in 1869, in 1882, and in 1889, but because of hoof-and-mouth disease in Europe importations have since been few. Generally popular through Europe and America.

Good cow should average 6,000 lb. of milk per year; for registered mature stock, the average is 13,744 lb. milk, with 547.55 lb. of butterfat; high record (1927), 22,622 lb. of milk, with 927.23 lb. of butterfat.

Hereford Cattle
Bos taurus

Beef type. Large, chunky, with white face and white markings on legs or under parts. Back broad. Legs short. Tendency in some toward abnormally large forequarters, which is desirable in draft animals. Poor milk producers. Mild disposition. Remarkably hardy, permitting them to thrive under severe open plain conditions.

Developed in England, in valleys of Severn and Wye rivers. Most successful in Western states where calves are shipped from ranges to Corn Belt for fattening. They can put on flesh rapidly with heavy feeding and are remarkably docile, also exceptionally good grazers.

Milk records of Hereford are negligible. Cattle normally show 35–50% shrinkage between live animal and marketable carcass. In Hereford, this shrinkage is remarkably low although it is not lowest of all breeds. About 55% of a living steer is normally beef.

Aberdeen Angus Cattle
Bos taurus

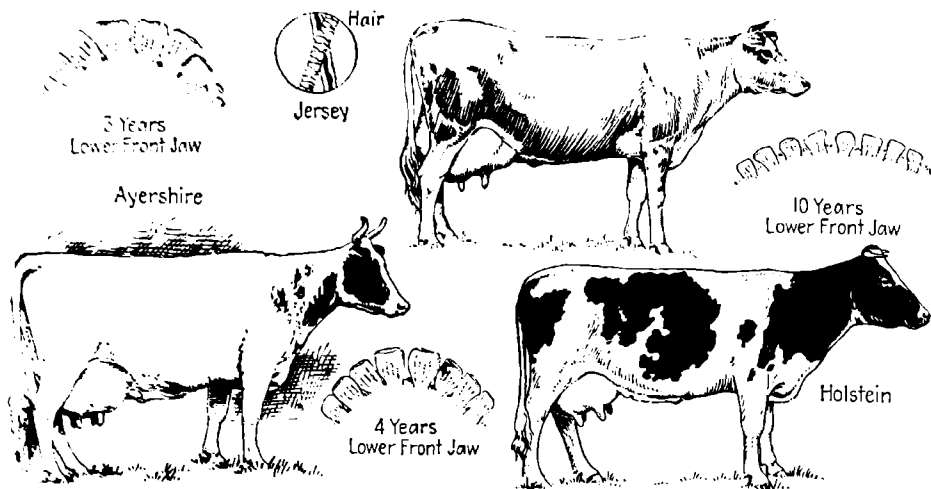
Hornless black beef cattle. Head comparatively short. Compact low-set body which produces about 65% high-grade marketable beef, with fat evenly distributed through entire carcass. Handled properly, a cow may yield a good flow of milk. Does well in close quarters; is quiet and generally good-natured.

Probably descended from a wild hornless breed. Probably developed in Scotland in the counties of Aberdeen, Kincardine, and Forfar, a section of which is Angus. Introduced into United States at beginning of this century, becoming popular particularly in the Corn Belt.

Best cattle for high-pressure system of feeding producing rapid development of "baby beef" that commands top prices. In 27 years, grand championships for single steers were won 22 times by this breed. Known in Scotland since 1752 as "doddies."

Domestic cattle trace their ancestry to 5 lines, probably as follows: 1. The bibovine group of southern Asia which includes the gaur; the banting of Bali, Borneo, and Malay Peninsula, which probably produced the zebu; and the gaur, which stands 6 ft. high and is one of the most powerful of wild beasts. 2. The leptobovine group, represented only by fossils from France, India, and Italy. 3. The bisontine group, which includes both the European and American bison and yak. (See p. 628.) 4. The bubaline group, which includes the water buffalo, Cape buffalo, and their relatives. (See page 628.) 5. The taurine group, which produced the ordinary beef and dairy cattle and humped cattle of Asia and Africa. The direct ancestors may have been one or more of these species: the extinct Indian ox, *Bos namadicus*, associated with men of the Stone Age; the ur, *Bos primigenius* of western Asia and all Europe, 6 ft. high at withers, a forest lover, which probably lived in historic times and was used in bull fights before 1500 B.C.; and the Celtic shorthorn, *Bos longifrons* of western Europe and the British Isles.

Cattle are primarily grazing animals. Normally eat 8 hours out of the 24 and no more, spending rest of time chewing cud and resting. When grazing, tongue is wrapped around grass, which is pulled or cut with teeth of lower jaw pushed against upper jaw. Grass about 4–5 in. high is eaten most rapidly. Cuts in 8 hours, with 2½ in. of teeth, about 150 lb. of green grass if pasture is good. This equals a pile 3 ft. high and 6 ft. in diameter. Will not eat grass growing from fresh droppings of their kind but will eat grass growing from horse or sheep droppings. Stabled cattle are usually fed regularly roughage and grain early morning and late afternoon. Require 2,804 cu. ft. of air per day per 1,000 lb. Hay or silage is fed at noon and water given twice a day. Milking is done at 12-hour intervals. Feeding rules call for abundance of balanced rations including variety, palatable forms, some succulent food, 8½ gal. of fresh water and some salt daily. A cow has 4 stomachs; the rumen or paunch, 80 per cent of total; the reticulum or honeycomb; the omasum or manyplies; and the abomasum or true stomach. Pulse 40–70. Respiration, 10–30. Temperature, 101.5°F.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Ayrshire Cattle
Bos taurus

Dairy cattle, red and white or brown and white, with white predominating and colors not blending. Horns long, upward, outward and backward curving and slender. Cow weighs about 1,000 lb., bull 1,400–2,000 lb. Top lines of animal straight. Legs long and straight. Barrel large. Chest full. Ideal milker. Long-lived.

Developed in southwestern Scotland, where it was established about middle of eighteenth century. Introduced into United States early in nineteenth century. Most popular in United States in Massachusetts, New York, Vermont, Wisconsin, and Kansas, chief dairy states.

Quality of milk is high and quantity good. A typical year's record is 25,328 lb. of milk, with 894.91 lb. of butterfat. Average good cow should produce 6,000–7,000 lb. of milk a year, yielding 3.8–4.5% butterfat. Some 20-year old cows have produced 10,000 lb. a year.

Jersey Cattle
Bos taurus

Dairy cattle bred for production of milk of high butterfat content. Solid color, yellow or fawn, with black nose, tongue, and switch though not always as just described. Small in size. Cow weighs 800–1,000 lb.; bull, 1,300–1,400 lb. Cow mild; mature bull nervous and unreliable.

Developed on Island of Jersey in the British Channel off the French coast. Island is 7 by 12 miles in area is mild through the year, and supports 50,000 inhabitants. No cattle but Jerseys are allowed on it. Introduced into United States early in nineteenth century.

Produces milk testing about 5% butterfat. One holds record of 20,616 lb. of milk a year; another has produced 1,141 lb. of butterfat a year. Since 1871, American records of Jerseys have been kept for about 1 million animals. Most popular in Ohio and Texas.

Holstein-Friesian Cattle
Bos taurus

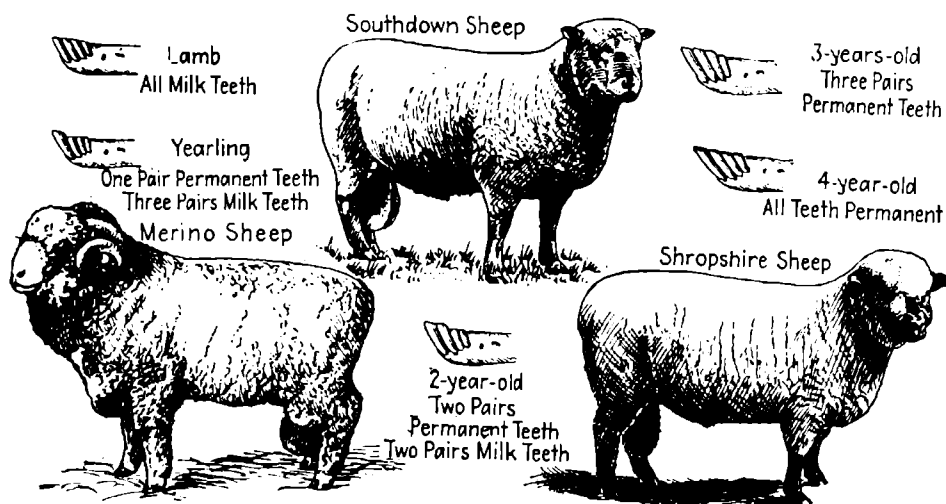
Dairy cattle, bred for great volume of good-quality milk. Black and white, though occasionally there are red individuals. Bull weighs to over 1 ton with a heavy framed body, muscular neck, lean body, and incurving horns; treacherous. Cow smaller, and gentle, with more slender neck, large body, and huge udder; average weight, 1,200 lb.

Developed in Holland and in Friesland and found generally over prosperous lowland Europe. Introduced into America about 1795, some going to Genesee Valley in New York. Later importations in the sixties established present high-grade herds popular in all dairy country in America.

One cow produced in a year 33,464.7 lb. of milk with 1,349.31 lb. of butterfat; another 37,381.4 lb. of milk with 1,158.95 lb. of butterfat. More than 80 have records of over 1,000 lb. of butterfat a year. These records speak for themselves.

9–10 months after a bull breeds with a cow, a calf is born. During second year, it is a yearling; in third year, a 2-year-old. Young female is a heifer but if a twin with a male, she is a freemartin and generally will not reproduce well. Calves run in fields together until 3–4 months old, then sexes should be separated. Male with testicles removed when young is a steer; if removed after matured, an ox. Ordinarily, a well-grown heifer may be bred at 18 months of age and continue as breeder 10–12 years. In heat, 2–4 days. Cow used to nurse another calf is a nurse cow. When a calf is born, cow is said to "come in" and when milk begins to flow as it does with birth of calf, cow is said to "freshen." Cows not producing milk are spoken of as "dry." Dry cows may be pastured but fresh cows require special feeding. Bull used for breeding is a service bull. Sperm from high-grade bulls are now shipped alive long distances and used to impregnate cows artificially. In artificial insemination, one bull fertilizes to 200 cows at one service and may father to 6,000 calves, as compared to normally 30 calves a year. This should increase herd quality tremendously. Average life span 15–20 years.

Cattle have been patient pioneer draft animals throughout world. Formerly, bull ran treadmill that churned butter. In some countries, steers are used as riding animals. Cattle yield leather useful in making windproof jackets, shoes, harness, and bookbindings. Hair is made into felt hats. Flesh is an important portion of most virile human beings' diet. Fat is used in lubricating machines. Milk sees most babies through their most difficult days and is ideal in diet of adults, supplying lime and a balanced diet in itself. Cheese provides a particularly valuable nonfattening diet. Casein from milk is used widely in industry in a variety of ways. Intestines provide strings for musical instruments, balloons for lighter-than-air aircraft, and have a variety of other uses. Glands provide medicines for restoring or preserving human health. Hoofs provide slow-drying oils for certain uses. Bones provide valuable fertilizers, ornaments, and utensils. Soap, sandpaper, insulin, all may come from cattle. In addition, cattle provide a welcome companionship for those who like them. Swiss, Limburger, cottage cheese and many other types are made from cow's milk.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Merino Sheep
Ovis aries

Bred for quality and quantity of fine wool. Ram weighs about 140 lb., ewe about 100 lb. Heavy folds over body but not on back. Wool covers head, obscuring eyes, but ears and muzzle are woolless. Has pink skin, long neck, sloping shoulders, narrow chest, and thin withers. Wool fine, 2-3 in. long.

Developed in Spain nearly 2,000 years ago. Introduced into United States in 1793 and later. Reached peak of popularity in 1812 and the 1860s. Saxon and French Merinos also imported. Now most popular in Texas, Ohio, Michigan, the Southwest, and Pennsylvania and used to improve other breeds by crossbreeding.

Ram's wool weighs to 30 lb., ewe's to 20 lb. 3 grades recognized, the lower weighing 18 lb. in comparison with the A-type that weighs 30 lb.

Southdown Sheep
Ovis aries

One of the smallest of mutton sheep. Ram weighs 170-190 lb., ewe 120-130 lb. Head medium-sized, hornless. Ears small and wide apart. Neck, short. Face brown or gray. Shoulders broad and full. Breast wide. Forelegs well apart. Back broad and straight. Rump broad. Fleece compact. Limbs short.

Possibly oldest medium wool breed in existence, having a distinct record from southeastern England for over 200 years. Probably developed from Sussex sheep. Introduced into America before 1803. Popular in Middle West, Tennessee, and New York but not in Far West. Formerly used to graze estates.

Lambs weigh 60-90 lb. in 4-6 months; ewe's fleece, 6-8 lb.; ram's fleece 10-12 lb.; average fleece, 7 lb. Carcass has a large proportion of marketable mutton.

Shropshire Sheep
Ovis aries

Medium-sized, general-purpose sheep. Fleece forms hood or cap over head and may extend to toes. Nose and lower legs dark. Legs short. Body blocky. Ram weighs 200-250 lb., ewe 150-180 lb. Skin pink, secretes oil freely. Ears short, pointed, wide-set, short-wooled, and carried almost straight out from head.

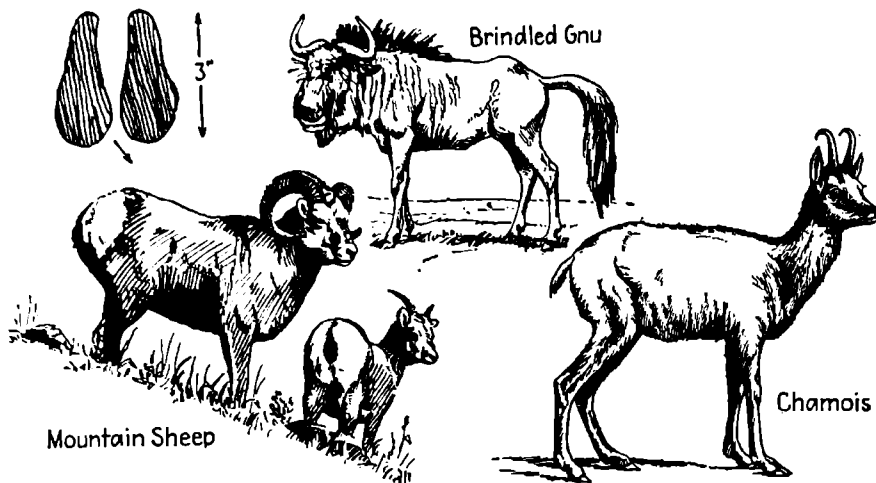
Developed in Shropshire and Staffordshire counties in west central England, probably from native sheep found there. Probably Southdown and Leicester blood used in crossbreeding. Not considered distinct breed until 1850, although it existed before. Common in United States and Canada. Quiet, docile, and easily handled.

Probably more generally used in farm flock states than other breeds because of good general qualities; used in grading up mongrel flocks. Fleeces average 8-10 lb. in weight, wool being of excellent quality. Tends to have twins.

One ram, over 1 year old, bred to 35-50 ewes at least 1½ years old. Ewes in heat 1-2 days. In 146 days, ewes bear 1-2 lambs. Ewes need 16 sq. ft. of floor space. Between breeding and lambing, ewes increase weight 25 lb. Lambs nurse in 2 hours; at 2 weeks, nibble hay; at 4-6 months, reach marketable age; tails cut when 2 weeks old and males castrated to become wethers. Southdowns may weigh 60-90 pounds at 3 months. At 1 year, permanent teeth appear and by 4 years, all teeth are permanent (see sketches). Pulse, 70-80. Respiration, 12-20. Temperature, 104-105°F. Life span 15 years.

Food, vegetation cropped close to ground; best if it contains clover. Sheltered sheep are fed legume hay and grain mixtures of corn, 4 parts by weight; oats, 4 parts; linseed or cottonseed cake, 2 parts and salt and water, which should be available at all times. Pregnant ewes require daily about 1-2 lb. of silage, 2-3 lb. of hay, and about 1½ gal. of water. Alfalfa can be recommended most highly as sheep forage. Bluegrass pasture does not provide adequate food during warm summer months. After weaning, heavier ewes may require milking by hand once every day or so until milk production is stopped. Sheep stampede blindly in face of enemies and are killed by dogs, bears, and other large animals. Goats or active aggressive cattle like Angus provide protection where dogs are a pest since they will drive the average dog from the pasture.

In 1938, there were in the United States approximately 53 million sheep worth 324 million dollars, number being greater but value less than that for hogs. Whole wool industry is, for the most part, dependent on breeds of sheep. The great centers in the earth producing wool are western United States, western Asia, and Australia. Sheep lend themselves to selective breeding, some producing rapidly growing lambs and good carcasses, others producing a high quality and quantity of wool. Then, there is a dual-purpose type which produces both wool and flesh. Associated with sheepherding are men, goats, and dogs, and now, in dog-infested areas, cattle. From the milk of sheep, Roquefort cheese is made. The enmities between sheepmen and cattlemen in the western ranges are hardly justified but poorly managed sheep do contribute definitely to soil erosion and floods and destroy game ranges and forested areas.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Mountain Sheep
Ovis canadensis

Ram, length to nearly 7 ft., with 5-in. tail; height at shoulder 3½ ft. Weight to 300 lb. Horns along curve, to 4 ft. Ewe, length to 5 ft., with 5-in. tail. Weight to 175 lb. Horns shorter and straighter; color brownish-gray above, darkest on back, back of neck, throat, and legs; brownish on sides; yellow-white beneath. Teeth: I $\frac{0}{4}$, C $\frac{0}{0}$, P $\frac{3}{3}$,

M $\frac{3}{3}$.

Found in mountains from western Texas and Mexico to North Dakota; west to southwest Alberta, north across Arctic Circle in Alaska and west to coast except along coast from Alaska to central California and narrow area in British Columbia, Alberta, and Washington. Feeds in lowlands when possible. 10 races.

Rams fight in late November and win flock of ewes. 1-2 lambs born 150 days after breeding; run and skip within 2 hours but hide until 3 days, when follow mother; nurse for 2 months, then eat solid foods. Rams past their prime by 8 years, as shown by annual rings on horns. Life span 15 years.

Food varies, according to authorities, from nothing but grass in northern ranges to little or no grass in South. All agree that sheep is selective. Must have water daily and must have salt. Sense of smell poor; of sight, remarkable. High mortality in sheep first winter. Captives are fed hay and oats.

Provides food, hides, and sport for mountain-dwelling and mountain-roaming men. Probably serves as food for wild preying animals and therefore a buffer for domestic animals, with which they are competitors for forage. Because of interesting habits, should not be allowed to become extinct. Tracks: F 2¾ × 2¾, 2; H 2¾ × 2¾, 2.

Brindled Gnu, Wildebeest
Connochaetes taurinus

Length about 7 ft., exclusive of tail. Height at shoulder over 4 ft. Face blackish, with sides of head yellowish-gray. Horns in both sexes arise from forehead, curve downward and then outward. Tail rather short and black. Dark transverse stripes on withers.

White-tailed or common gnu, whose tail almost reaches ground, now almost exterminated from former range in South Africa. Brindled gnu, found in southeastern Africa from Orange River north to beyond Victoria Nyanza, is still reasonably abundant. A third form, *C. albojubatus*, occurs in British East Africa.

Both sexes have horns but body and horns of female white-tailed gnu are slightly smaller than in male. Young wildebeests are tamed relatively easily but mature animals resent vigorously any confinement.

These are highly inquisitive grazing animals. They may circle a stranger and come up to investigate him from rear. They can march speed with a horse and have excellent endurance. They have excellent sight and good ability to smell but are inclined to be ruled partly by behavior of others in the herd.

They have been killed extensively for their flesh, which is tender and juicy; for their hides, which make excellent leather; for their horns, which make good tools for natives; and in part, because they compete for forage with domestic animals that man wishes to use for his own ends.

Chamois
Rupicapra rupicapra

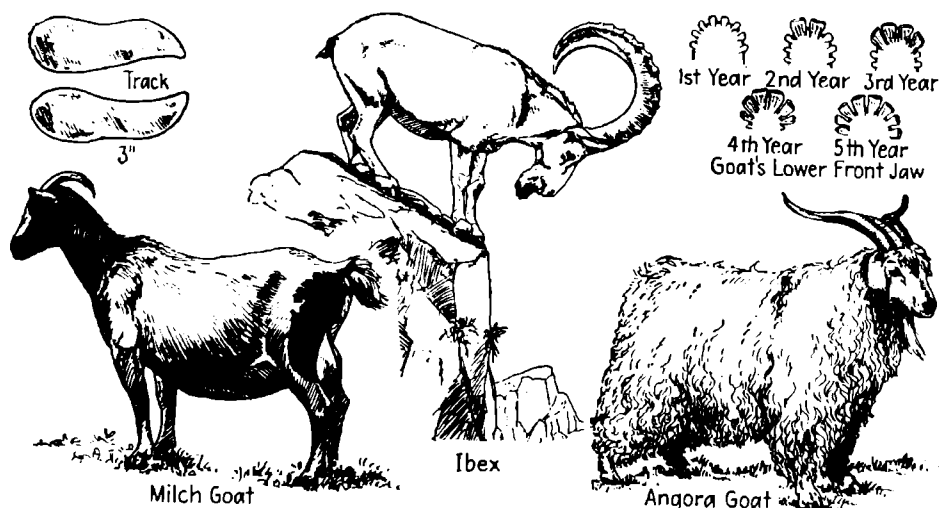
Length, average, 45 in. Height at shoulder, 2 ft. Weight to 90 lb. Bucks larger than does but superficially like them. 2 black horns rise vertically from top of head to 8-10 in. and at tips bend backward and downward. Hair close and long, with thick woolly underfur.

Ranges through mountains of Europe; while it is essentially a mountain animal it is not limited to treeless stretches but lives for most of time in tree belt just below tree limit. They live together in flocks and have been protected somewhat in game refuges.

1-3 kids are born in May-June and follow mother almost immediately. In a few days, they can spring up exceptional heights. Kids stay under protection of doe for at least 6 months, receiving best of care, and may not leave mother even if she is killed. Kids may be tamed and will breed in captivity.

Bucks live solitary existence. Rest at night; feed down mountains until noon and up in afternoon. May leap 23 ft., and a captive animal has been known to clear a 13-ft. wall. Senses of smell and hearing are exceedingly acute. Old animals may become vicious and attack with their horns.

Excellent game animals, with superior flesh. Hides make chamois leather. Horns valuable, and animals add definitely to picturesque quality of their environment. Their continued existence should be guaranteed by adequate regulations for protection.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Artiodactyla. Family Bovidae. HOLLOW-HORNED RUMINANTS

Milch Goat
Capra hircus

Good milch goat has long body with proportionately large hindquarters. Chest deep and broad. Legs short. Neck medium in size. Head broad. Mouth wide. Udder not wide; full, not tight. Skin soft and covered with short hairs. Body hairs fine, smooth, and bristling. Often without horns. Playful and friendly.

Raised more commonly in Europe, where in Germany 75% of rural households maintain them. In America, suburban goat dairies supply milk for special purposes recommended by doctors. Goats are kept by those of foreign extraction to give milk where forage is too poor and limited to support a cow. Of Persian origin.

2-4 kids born 147-155 days after male *buck* breeds with female *nanny goat* or *doe*. Kids, well-developed at birth, follow mother in 4-5 days, mature in 8-12 months; old at 6 years but may live to 15 years. 1-year goat has 2 broad front teeth on lower jaw; second year, 4; third year, 6. Body temperature, 103°F.

Food almost any vegetation, but not the tin cans of legend. Animals may be destructive to forests. They have keen sight and sense of smell, are wary and restless, and delight in climbing to highest available point. Bucks have a decidedly unpleasant odor.

Healthy female gives milk for 7-10 months after kids are born, so serve splendidly as milk source for man. Flesh is known as "venison" in the markets, and castrated males or *wethers* may be slaughtered for flesh. Milch goat makes good child's pet for drawing carts; bucks are sometimes dangerous. See also column 3.

Ibex, Wild Goat
Capra ibex

Length to 5 ft. Height at shoulder to 3 ft. Weight to 200 lb. Both sexes have horns that curve obliquely backward, tapering gradually and reaching a length of 59 in. and a weight of 30 lb. Fur rough and thick, and in males like a mane on back of neck and a short beard on chin. Gray in winter, brown in summer.

Found in mountainous parts of Switzerland, the Pyrenees, the Caucasus, and Abyssinia. Close allies include Alpine ibex *C. ibex*, Himalayan ibex *C. sibirica*, Arabian ibex *C. sinaitica*, and Abyssinian ibex *C. waliae*. All live for most part in the dizziest mountainous area available, though some may be relatively tame.

Males do not live with herds except at breeding time; males usually live higher in mountains than females. 1-2 kids are born in June-July and a few hours after birth can follow mother nimbly over rough terrain. Mother protects kids by fighting, by decoying enemy from young, and otherwise.

Food, vegetation gathered mostly during night, animal descending in late afternoon to graze and retreating to forest higher up at daybreak. They feed on trees, shrubs, grasses, and almost any other available plant materials. Chief enemies of young are eagles, though wolves, bears, and men are often serious.

Serve as game and food animals for those living within their range. When raised in captivity, they quickly lose fear and respect for human beings and have been known to enjoy bowling men over with their horns, apparently just for the fun of it.

Angora Goat
Capra angorensis

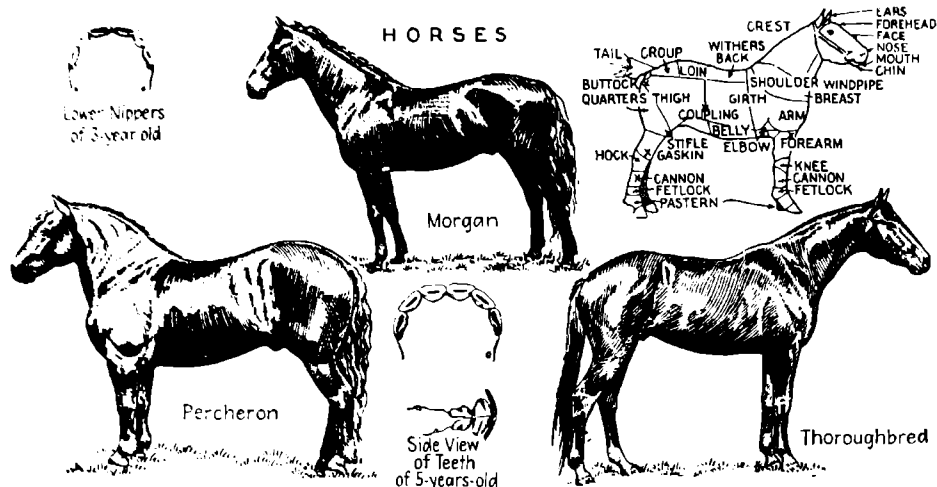
Buck may weigh as much as 100 lb., with 18-20-in. horns. Doe smaller, with 8-10-in. horns. Hair long and relatively fine, a single goat capable of producing a fleece of 8-in. hair weighing an average of 3-5 lb. Maximum is 12 lb with 18-in length. Buck has a characteristic long slender beard under chin.

In America, raised in limited numbers in East and Middle West but commonly in South and Southwest. Related breeds include Cashmere (2 ft. high) of Tibet, Syrian (long-eared), Sudan, and Egyptian goat. Names indicate geographic origin of breeds. Goats are reared on lands that will support sheep.

In range, kidding time is important. Since newly born kids cannot stand strenuous activities of a herd, doe is toggled so that she cannot leave and where the herd will not bother her. Kids kept 2 weeks, then grazed with doe in special pastures. One buck to 50 does is herd practice and spreads kidding time.

Pastured milch goats need daily 1½ lb. of concentrates such as 10 parts of corn by weight, 10 parts of oats, 5 of wheat bran, and 1 of linseed-oil meal; also, good roughage. Hair goats must have water summer or winter. Herds of 1,200 hair goats commonly managed together.

Good hair goats may be clipped twice a year. Hair is sorted according to fineness and made into mohair cloth. Trained sorters can recognize 13 diameters between 0.003 and 0.0067 in. and sort 500 lb. of hair a day. Only 1 in 10,000 men are able to do this and they require at least 3 years' training.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Perissodactyla. Family Equidae. HORSES

Percheron Horse
Equus caballus

Maximum height at withers 17 hands, or 68 in. Short-legged, compact form is favorite. Back and rump broad. Back short. Loins smooth and well-muscled. Gray, roan, or brown but black and gray typical; chestnut typical of Suffolk breed but not of Percheron. Body less blocky than Belgian and legs less "feathered" than long-legged Clydesdale or short-legged Shire. May weigh 1 ton at 3 years.

Developed in Perche district of France near Paris and probably associated with Crusaders. Popular in America in Civil War times and now leading American draft horse, one census showing 70,616 Percherons, 10,838 Belgians, and 5,617 Shires. Most popular in Middle West.

Makes excellent heavy-artillery horse because of quick action, patience, and intelligence even though sometimes clumsy in harness. Powerful worker in mud.

Morgan Horse
Equus caballus

A general-purpose horse, formerly popular as a general farm animal. Usually bay, standing about 14 hands (56 in.) high at withers. Weight about 1,000 lb. Endurance remarkable. Legs short and well-muscled. Back short, with long sloping shoulders; round and close-ribbed. Chest wide and deep. Feet small and well-shaped. Mane and tail long. Legs dark. Ears small. Keen. Even-tempered, with quick response.

Descended from a stallion, Justin Morgan, that was foaled in 1793 and died in 1821 in Vermont, where it was brought from Massachusetts. General qualities nearly lost when it was bred as a race horse but have been regained. The breed held many trotting and running records.

A famous Morgan horse, Gladstone, foaled in 1913, was worked through the hay season, then under saddle entered endurance field and bettered records made by horses 200 lb. heavier.

Thoroughbred Horse
Equus caballus

Reaches a height at shoulder of 14½–16½ hands, or 5 ft. Weight 900–1,100 lb. Form extremely graceful. Legs long and slender. Neck light. Color bay or brown, though blacks, chestnuts, and grays are found. Color usually uniform. Characteristic form maintained through many years of careful selective breeding. Nervous, generally friendly animal, much beloved by master and subject to best of care.

Developed in England for racing, tracing lineage over 200 years, with selection based on performance. Occasionally stallions are bred with mares of other breeds to improve speed of such types as polo ponies, artillery horses, hunters, cavalry, and general saddle horses.

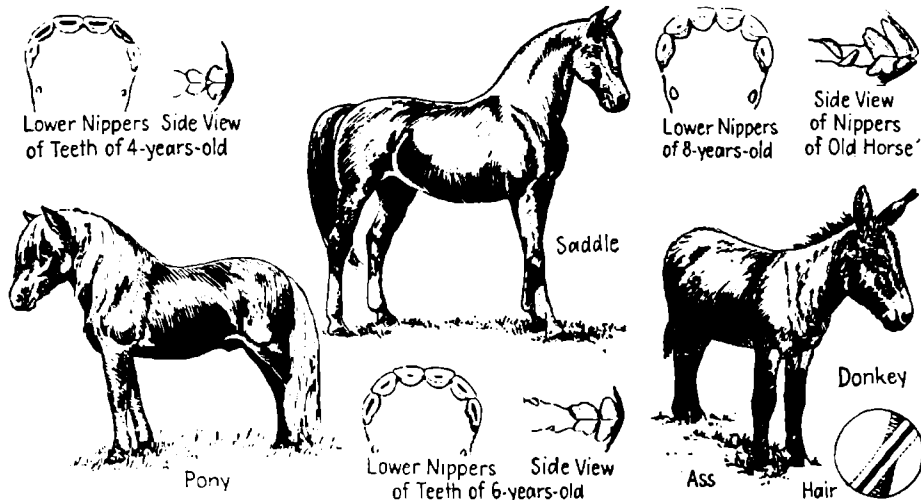
In 1932, Equipoise ran a mile in 1 minute, 34½ seconds. In 1920, Man o' War ran 1¾ miles in 2 minutes 14½ seconds. He won \$249,465 before he retired for breeding purposes; was never required by competition to extend himself but was second in one race.

Believed developed from small *Eohippus* of early Eocene, which had 4 toes on forefeet and 3 toes plus 2 splints on hind feet; then collie-sized *Orsippus* of late Eocene with somewhat similar toes; then *Mesohippus* of Oligocene with 3 toes on all feet, side ones touching the ground in hind feet; then the Miocene 3-toed *Merychippus* of the Miocene, none of whose side toes touched the ground; then the 1-toed *Pliohippus* of the Pliocene, with splints of second and fourth toes remaining off the ground. The horse *Equus* appeared about Pleistocene times.

Horses just born are *foals*; when weaned from mother they are *weanlings*. A young female is a *filly* and a young male a *colt*. Race horses date their age from their first January 1. A mature male horse is a *stallion*. A male castrated before it reaches maturity is a *gelding* and one castrated after reaching maturity is a *stag*. A mature female horse is a *mare* and one nursing young is a *broad mare*. A foal is born to a mare 11–12 months after she is bred to a stallion. Horses should not be worked until 2 years old. Mare in heat 5–7 days, may be bred at 12–24 months, but ordinarily not until 3 years old. Life span to 50 years.

Young horses should grow steadily first 2 years. Oats are popular as grain food because hulls add bulk and prevent gorging. After being worked, horses should be given a small drink, then rested, then watered again, and then fed. In pasture, horses have definite midden heaps for manure where they do not graze, but will eat grass growing from cow droppings. Eat grass closer than cattle but not so close as sheep. Abundant roughage necessary when confined. Respiration, 8–16. Heart beat, 30–45 per minute. Temperature, 100.2°F.

Number of horses varies; 16 million in United States in 1925 and 10 million in 1940. They provide companionship and perform work. They may be eaten in emergency. They produce great quantities of scrums used in keeping men and other animals healthy. Horses have definitely helped make life better for man and other animals. They are worthy of every consideration. 1,000-lb. horse needs 3,401 cu. ft. of air daily.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Perissodactyla. Family Equidae. HORSES

Shetland Pony
Equus caballus

Small animal, not accepted for registration if over 46 in. high at withers. Mature stallion weighs 370-400 lb. Ponies have short strong straight legs. Body well-rounded. Back broad. Head well-carried on short neck. Mane heavy. Tail thick. In winter, hair grows long, a relic of meeting severe winter conditions.

Developed in Shetland Islands, which lie off mainland to north of Scotland. When introduced into favorable conditions, it tends to increase in size. Introduced into America largely for sale as a pet or as a trained circus animal. Pied animals seem to be popular as pets. Often so pampered that it develops away from small size.

Ponies have a life span of about 21 years though some live much longer. They accept all sorts of obligations, ordinarily with little sign of offense.

Ponies seem able to exist on forage which would not support larger breeds and so have made a place for themselves in less fertile areas of the earth.

Though small, a pony can draw $\frac{1}{2}$ ton of coal in a mine 20-30 miles a day. A pony 3 ft. high can carry a full-grown man with ease. As a pack animal, it carries loads of 120-140 lb. and in spite of such treatment remains good-tempered. Obviously, it is popular.

Saddle Horse
Equus caballus

Bred for saddle purposes. Height 14-16 hands (5 ft.) at withers. Weight 950-1,250 lb. Color bay, brown, black, or chestnut. Stride generally short. Shoulders long and sloping, favoring smooth easy action. Has spirit and style and when well trained is quick to respond to command.

Breed of American origin; developed in Kentucky, Tennessee, and Virginia where it was needed in supervising plantation work and on hilly grazing farms. In the North, a horse was needed with a varied gait involving a canter, a walk, and a trot, which led to the loss of some other gaits common to the breed in the South.

American Saddle Horse Breeders Association was organized in 1891 and in first 36 years of its existence listed in its studbook 10,215 stallions and geldings and 17,046 mares. One of the greatest saddle-horse sires was Gain's Denmark, in the ancestry of most of the breed now.

Horses may have unfortunate effects on certain people, giving them asthma. Progress is being made in immunizing such persons to these ill effects but until this has been perfected many will be denied the pleasure of riding good saddle horses.

Saddle horses are becoming more and more horses of the show type with specialized gaits and particular conformations in build. Though spirited, they generally yield well to discipline and so are always interesting.

Ass, Donkey, Burro
Equus asinus

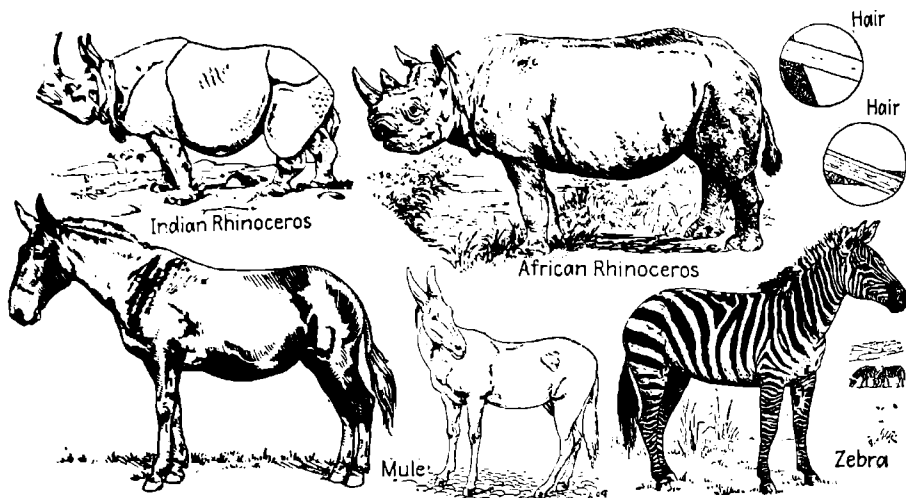
Varies in height from 30 in. to height of a good-sized horse. Ears long. Tail sparsely haired. Eyes deep-set. Body generally not so heavily nor so smoothly muscled as that of horse. Mane wiry, uneven, coarse. Legs medium in length. Feet small. Color from white to black. Commonly with white on nose, belly, and flanks.

Domesticated for thousands of years. Jacks of France are probably largest; those of western India and Ceylon, smallest. Wild in Africa and Asia. Brought to America with Spanish explorers, but serious production began with nineteenth century. Popular, particularly in mountainous regions.

By selection, important breeds have been developed: Poitou, largest; Majorca, large; Andalusian, medium; and Maltese, small. Male donkeys are jacks. Female donkeys are jennets. A jack mated with a mare produces a mule; a stallion with a jennet, a hinny. Pregnancy, 348-377 days.

Donkeys can get along on poor forage and so are popular in less favored countries, among less favored peoples, or on long journeys where food cannot be carried. They do better in warm climates than in cold. Body temperature, 98.5°F. Pulse, 45-52 per minute.

Donkeys are ideal pack animals, mine animals, and pets. Jacks are bred to great size for mating with mares for production of high-grade mules. Their size, endurance, and good qualities have been greatly improved in recent years. A pack animal can carry 250 lb. on its back for days with little forage.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Perissodactyla

Family Equidae

Mule

Equus asinus × *E. caballus*

Varies in size according to use. Draft mule weighs about 2,000 or more pounds and is 16 hands (64 in.) high at withers. Farm mule weighs 1,100 lb., 15½ hands high. Mining mule weighs 600-1,300 lb. and is 12-16 hands (48-64 in.) high at withers. Mules retain long ears, small feet, sparse tail, and bray of jackass, with size and strength of mare.

Probably has been produced ever since horses and asses have been domesticated. About 90% of United States mules are on farms of South. Generally popular where hard patient work is needed, particularly in warmer parts of world. About 2½ as many mules as horses in United States.

A stallion mated with a jennet produces a *hinny*. These not bred commercially because they lack good qualities of reverse cross, where jack is mated with a mare to produce a *mule*. Mules are born about 1 year after breeding. Reports of female mules bearing young not well supported.

Mules are less inclined than horses to eat when they are heated or tired but must have ample food to consume when they are well rested. Mules most nearly like their mothers are considered superior.

Make ideal army draft animals because of lack of nervousness, great strength, endurance, and ability to get along on poor care. A mule cannot be put at hard labor safely until 5 years from time parents mate and many must wait 6 years. 4,477,000 mules in United States in 1938.

Zebra

Equus chapmani

The wild mountain zebra stands about 4 ft. tall at the withers. Its general color is white with black stripes on head, body, neck, and legs. Burchell's zebra stands 4½ ft. high and usually has white legs with body and head stripes black or brown over sorrel. The quagga stands 4½ ft. high and has stripeless haunches and legs.

Mountain zebras originally ranged through mountains of Cape of Good Hope in Africa. Burchell's zebra *E. burchellii* is native of the great plains of southern Africa, and the quagga *E. quagga* has recently probably become extinct. Chapman's zebra, *E. chapmani*, ranges over central Africa.

Reproduction is probably much like that of donkey and horse. Burchell's zebra foal is born between 11 months and 6 days and 11 months and 20 days after breeding takes place. Usual life span of a zebra is around 20 years, though probably few survive that time in the wild. Herd together for life.

Zebra is a grazer like its horse relatives. In nature, it is the favored prey of lions but a group can defend themselves well against lions with their heels, with which they are expert marksmen. Call of a zebra is a peculiar neigh something like a donkey bray but more pleasant. Animals feed in herds in the wild. Speed, 40 m.p.h.

Zebras are prized as food by native Africans who enjoy the yellow fat. They use hides for clothing, shelter, and implements and sometimes have been able to break a few animals to harness if they were caught young or reared in captivity. Sometimes used with teams of mules.

Family Rhinocerotidae

Rhinoceros

Rhinoceros bicornis

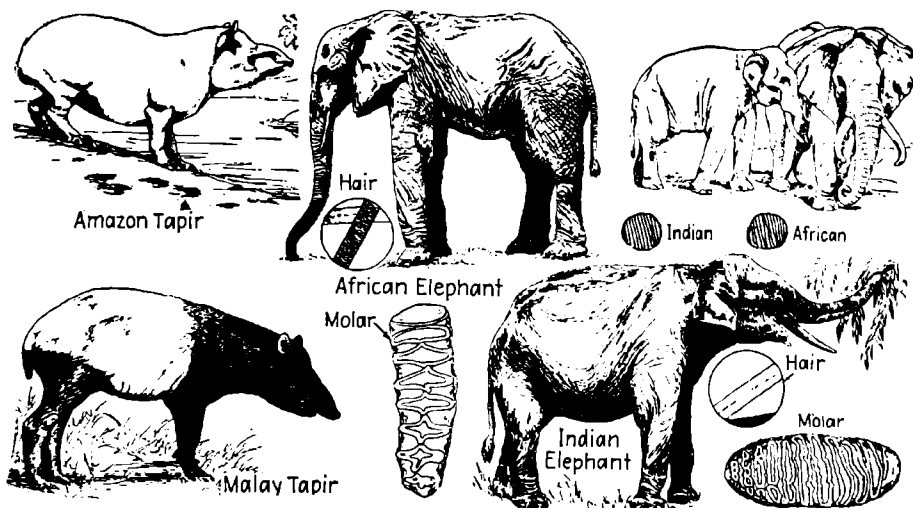
Indian rhinoceros *R. unicornis* largest of 3 Asiatic species; has only 1 horn, measures 10½ ft. from nose tip to tail base, and stands 6 ft. at shoulder. African rhinoceros stands 4½ ft.; 8½ ft. in length. It makes a track 9½ in. across. Its front horn is the larger and may be 3 ft. long. Horn of black rhinoceros, to 5 ft. To 6,000 lb.

Indian rhinoceros native of Asia. Java rhinoceros includes 1-horned rhinoceros of Java, small Sumatra rhinoceros, and 2-horned rhinoceros of Sumatra, Thailand, and Malay Peninsula. 2-horned African rhinoceros, from Abyssinia to the Cape in Africa. In 1731, a hair-covered frozen rhinoceros was found in Siberia.

Not a sociable animal. Young born 19 months after breeding takes place, always 1. At seventh year, first horn appears in the Sumatra species. Young rhinoceros remains with mother for some time. Life span, judging from zoo records, is about 25 years though this must vary in the wild. Few enemies dare face it.

Food, plant material, commonly twigs and shoots of mimosa and similar woody plants. Sense of sight is poor but those of hearing and smell excellent. Charge of an angry rhinoceros is direct, powerful, and dangerous. Enjoys mud wallows as insect protection. Speed, to 28 m.p.h.

Superior game animal but should not be completely exterminated. Natives eat the flesh of some species, value the dried blood at \$1 per lb., consider the skin a delicacy, and consider the horn worth \$10 as an infallible magic love stimulant. Horn, like the tusks of elephants, is not bone.



PHYLUM CHORDATA. CLASS MAMMALIA

Order Perissodactyla
Family Tapiridae

Order Proboscidea
Family Elephantidae

Malay Tapir
Tapirus indicus

Length 8 ft. from nose tip to root of tail, with head, neck, and limbs brownish-black, back and sides grayish-white. American tapir, *Tapirus americanus*, is about 6 ft. long and 3 ft. high, dark-brown or black with a gray tinge on head and chest. Can swim and dive well but is not a good runner.

Black and white tapir found from dense jungles of Malay Peninsula to Sumatra and Borneo. South American tapir, uniform dark brown, along rivers and lakes of South America north of Amazon. Giant tapir (700 lb.), in mountains of Central America and southern Mexico. All are essentially animals of dense jungles in America or Asia.

Single young tapir is born from 392-405 days after parents breed. South American tapir will breed in captivity, but few records are available about any wild tapirs and their general life history. Young Malay tapirs are brownish-black, with brownish-yellow spots and streaks on sides, and white beneath, but lose this at 6 months.

Food, succulent vegetation of thick jungles where water is tepid and abundant. Tapirs favor a temperature of 70°F. but do well in warmer climates. Do not like each other. They are defenseless, serene, patient, and generally accept life as fate hands it to them. Jaguar is chief enemy.

Tapir flesh is considered to be as good as beef and is sought by natives. Skins are made into leather for harness but, being hard when dry and spongy when wet, are not suitable for shoes. Young tapirs are tamed relatively easily and often wander about towns where they have been welcomed.

African Elephant
Loxodonta africana

Length to 10-12 ft. Height to 13 ft. Weight, male, to 13,000 lb. Skin about 1 in. thick, nearly black. Ears to 5 ft. long and 4 ft. wide. Eyes small, well protected with lids. Forefeet usually with nails on 4 toes. Hind feet with nails on 3 toes. Trunk wrinkled, an elongation of upper lip, sometimes 7 ft. long. Male larger than female. Tusks to 10 ft. 2½ in. long, weighing 226½ lb.

Found south of the Sahara through wilder parts of Central Africa and formerly on south to Cape of Good Hope. Ancestors of elephants date back to Eocene; upper Eocene-Lower Oligocene, *Moeritherium*; Oligocene, *Palaeomastodon*; Pliocene, *Mastodon*.

First molar appears during second week after birth; is complete and in use at 3 months and shed at 3 years; second molar, in use at 2 years and shed at 6 years; third molar appears at 2 years, in use at 5 years and shed at 9 years. These are milk teeth. First true molar, fourth grinder, appears at 6 years, shed at 20-25 years; second true molar appears at 20 years, shed at 60 years; third and last appears at 40-50 years.

Food exclusively plant materials. African elephants enjoy the sun; may sleep either standing or lying down; may travel 15 m.p.h. by sure-footed rolling gait. Elephants never canter, gallop or trot. They have many parasitic enemies. Man is their worst large enemy.

African elephants do not yield to domestication as do the Indian species. They are hunted by natives for flesh and hide but more for ivory of tusks. African elephants can do much damage to crops, generally at night. They should not be completely exterminated however. Jumbo was an African elephant. At 26 years, when he probably had not completed his growth, Jumbo stood 11 ft. 2 in. at the shoulder and weighed 6¾ tons.

Indian Elephant
Elephas indicus

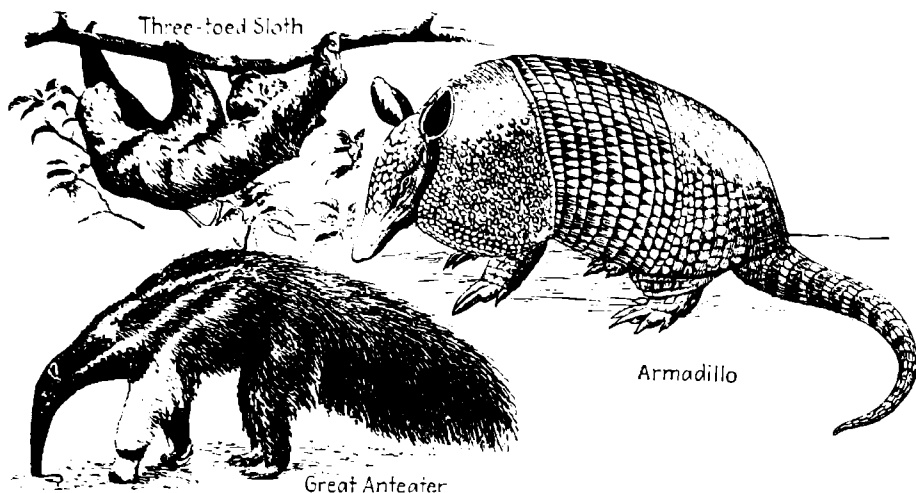
Smaller than African elephant, with a weight of 12,000 lb. Shoulder height varies from 7 ft. 9 in. to 10 ft. Forefeet with nails on 5 toes. Hind feet with nails on 4 toes. Ears ½ size of those of African elephant. Trunk smooth. Female Asiatic elephant sometimes tuskless; Ceylon elephants generally tuskless. Tusks may measure 9 ft. and weigh 150 lb.; are really incisor teeth. Brain weighs 10 lb.

Indian elephant is widely used as a draft animal in Asia and to some extent in Africa. It originated in southern Asia, India, Burma, Thailand, and French Indo-China, Ceylon, Malay Peninsula, and Sumatra. Common elephant performer in circuses. Becomes full-grown at 25 years and usually lives to about 50 years.

Single young born 18-24 months after breeding. Bull breeds at 11 years, cow at 8 years. Young weighs about 200 lb. at birth and stands about 3 ft. high. Matures at 11 years. In wild, form herds of 50 or more with 1 or more old males.

Food essentially plant material, about 40 per cent of food eaten being digested. Pulse of elephant standing in day, 42-46; standing at night, 30-37; lying, 35-47. Heat production, 2,000 cal. per sq. in. of surface per day, the largest of any known animal. Skin temperature, 84-86°F., body temperature, 97.6°F. Hearing acute. Speed, 2½ m.p.h.

Natives relish flesh, particularly of trunk and foot. Most valuable animal because of ability to do intricate work under direction. Machines are gradually replacing them. Rogue elephants may do great damage to crops and kill men.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Edentata or Xenarthra

Family Brachypodidae

Three-toed Sloth
Bradypus griseus

Length 18-20 in. Of a uniform gray color, though sometimes greenish because of algae in one species. This species has long blackish stripe between shoulders. 3 toes on each foot are long and curved like hooks. 2-toed sloth, *Codreops hoffmanni*, has 2 toes on front, 3 on hind feet.

B. griseus found in flooded parts of Central and South American forests, with closely related form in drier parts. Amazon River is roughly southern limit of both 2- and 3-toed sloths. Hang back down, from branches in trees, using claws as hooks to hold on.

Usually only 1 young, which clings to mother's back until it can shift for itself. Are tolerant of each other, this being particularly true of females. When an animal with a body temperature of 91.5°F. in air temperature of 79°F. was shifted to air at 57.3°F., body temperature became 86°F. in 5 hours.

Food almost exclusively leaves of cecropia tree, though twigs are eaten as well as leaves. Animal known to go 4 miles in 48 days, despite slow movement: to swim 65 ft. in 2½ minutes; and to go overground 14 ft. in 1 minute. Has many enemies, particularly large birds of prey.

Probably of little economic importance to man but interesting because of unique habits. One species is known to natives as the "Ai," named probably because of its plaintive cry. Apparently life habits have not been thoroughly studied, since they are not discussed often in literature.

Family Myrmecophagidae

Great Anteater
Myrmecophaga sp.

Length about 4 ft., plus tail at least 2½ ft. Height about 2 ft. Hair stiff and bristly. Throat, chest, under parts, and underside of tail black to brown, with broad black strip bordered with white from shoulders over rump. Upright mane on neck and back. Tail hairs sometimes 16 in. long. Fore-foot claws long and curved.

Found in Costa Rica, Panama, northern South America, in forests. 3-toed anteater, *Tamandua*, with long prehensile tail, a tree dweller from Mexico south. 2-toed anteater, *Cyclops*, found from Mexico to Panama; strictly arboreal and small, about size of squirrel with long tapering tail; claws on only 2 toes.

Breeds once a year, there being only 1 young animal, which rides around on its mother's back long after it should be able to take care of itself; sometimes this continues until a new young one is born. Habit is similar to that of closely related sloths. Little known about family life.

Food essentially ants, in all stages, these being caught by tearing anthills and houses to pieces with strong claws and eating with sticky tongue, which can be extended 20 in. and worked in and out rapidly. Can go a long while without food. In zoos, thrives on beaten raw eggs mixed with scraped uncooked meat and milk.

Flesh, which is black and has a musky flavor, is eaten by natives. Animal rarely fights back even when attacked by mortal enemy, the jaguar, and even though its sharp claws could be effective weapons. Interesting zoo animal. Hide sometimes used for wall ornament.

Family Dasypodidae

Nine-banded Armadillo
Dasypus novemcinctus

Length to 28 in., plus tail about 1 ft. Weight to 15 lb. Body covered with bony plates, with 7-9 movable joints around middle, permitting animal to curl into well-armored ball and protect softer parts. Color, variegated flesh, gray, and black. Snout, ears, and toes long. Toes 4 on front feet, 5 on hind. Teeth: $I \frac{0}{0}$, $C \frac{0}{0}$, P and $M \frac{8}{8}$.

Found among rocks where there is vegetation and where caves are accessible, from sea level to 10,000-ft. elevation, from Alabama, Louisiana, and lower Rio Grande country south into Mexico. North to 33°N.L. in Texas and adjoining parts of Louisiana. Usually active at night or when light is poor.

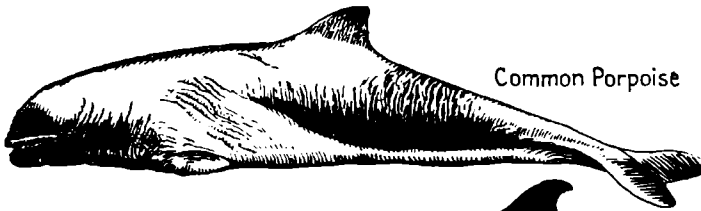
Sexes resemble each other and show no seasonal variation. Young born in litters of 4, all one sex and "identical," from first of February to April, with soft flexible skins much unlike the hard shells of adult; eyes open when born; able to leave den and follow mother like a flock of little pigs shortly after birth.

Food almost exclusively (85%) insects, chiefly ants and beetles, mixed with earth; 13% vegetable. Droppings like small clay marbles. Poor sight, excellent ability to smell, particularly sensitive to jarring of earth. Can run surprisingly fast for short distances.

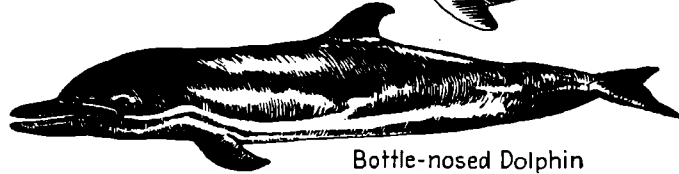
In some parts of range is discouraged as destroyer of ants that serve as useful scavengers, and in other places disliked by gardeners whose work it disturbs, even though it is engaged in destruction of important plant enemies. Body temperature may drop 6-8° in 4 hours.



Manatee



Common Porpoise



Bottle-nosed Dolphin

PHYLUM CHORDATA. CLASS MAMMALIA

Order Sirenia Family Trichechidae

Manatee, Sea Cow

Trichechus latirostris

Length, male to 12 ft. Weight to over 1,500 lb. Female to 7 ft. Dull lead gray in color. Hairs sparse and colorless. Snout blunt and apparently sensitive. Eyes small. Ears inconspicuous. Body fish-like in shape, without any "hind legs," but tail is about $\frac{1}{4}$ length of animal.

Florida manatee, *T. latirostris*, found in shallow salt or brackish waters from Florida around Gulf of Mexico and in West Indies. It is now becoming rare. Other manatees are found in South America and in Africa. In Pacific Ocean, it is represented by the dugong.

Breeds in shallow water. 1-2 calves born in water, each weighing about 60 lb. at birth. Mother must hold young out of water for air every 3-4 minutes for first week; nurse 18(?) months. A young of the smaller Amazon species, 3 ft. long, weighs about 30 lb. Parents help rear young, which stay until next young are born.

Food probably exclusively succulent plants, gathered mostly at night, or in some species by day. Rests in water with back arched, head and tail depressed. Average time under water 1 minute 17 seconds; longest, 3 minutes 49 seconds. Body temperature about 100°F. with water temperature of 78°F. Sense of touch excellent; of sight and smell, poor.

Flesh makes excellent food; breast meat light-colored; pelvis region, red meat; spare ribs, fat. In captivity, may be fed successfully on 1 loaf of bread daily. Hide makes superior leather for use in valves. Should be rigidly protected until its survival is assured. Many killed in 1939 in cold in Florida.

Common Porpoise

Phocaena phocaena

Length to 6 ft. Head beakless. Dorsal fin triangular, slightly behind middle of body, low and only slightly concaved on its rear margin. Flippers oval, blunt at ends, and proportionately small. Back black. Belly white with narrow gray area between. Teeth spade-shaped instead of conical. Weight to 120 lb.

Found in north Atlantic from Davis Strait down to New Jersey. A coast lover and one of commonest species seen from shore. Known in the Mediterranean.

Breeds in summer months and about 11 months later 1 young, about half length of mother, is born. Young suckled while mother swims on side, thus permitting young one to get air while it gets nourishment. Life span to 30 years.

Food, fish such as herring, sole, whiting, and crustaceans; cuttlefish and even plants. It not infrequently gets caught in fishermen's nets and, not being able to get to the surface, drowns as would any other air breather. It also swims along beside boats.

Flesh was formerly considered good food and in the time of Henry VIII was a royal dish. Its oil was formerly used in lamps. It probably does destroy some useful fish and may injure fish nets.

Bottle-nosed Dolphin

Tursiops truncatus

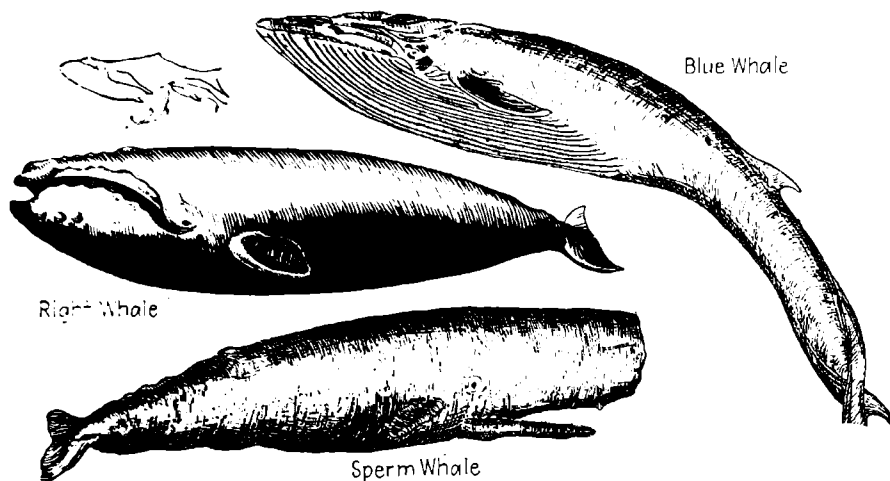
Length to 12 ft., with well-defined snout of 3 in. A prominent black or dark gray-brown fin in middle of back. Belly white. Head and snout dark, but upper edges and lower jaw white. Common dolphin, *Delphinus delphis*, is 8 ft. long and has a 6-in. snout and a ring of black around eye. Belly, black and white.

Bottle-nosed dolphin is commonest Atlantic species. Found from Maine to Florida, the Bay of Biscay, the Mediterranean, and even in New Zealand. In British waters, it is in Devon region early in the year and Essex region later.

Courts by swimming upside down. Breeds from spring through summer, young born probably 10 months later. Young nursed about 15 minutes, at 30-minute intervals but can submerge only 30 seconds at first. Fish swallowed at 4 weeks makes young sick but, beginning with eleventh week, eats 11 lb. fish in 3 weeks. Still nurses at 14 weeks of age.

Food, fish. One reported to have eaten a 4-ft. shark headfirst, but this killed the dolphin. Sleeps floating on water. Can see distinctly 50 ft. through air, but can hear fish hit water farther; possibly follows schools of fish by their slapping on the water. Can swim at 30 knots at least. Can whistle to communicate.

A commercial fishery dependent on this species was once established at Cape Hatteras, N. C., and from November, 1884, to the following May, 1,268 were captured and processed.



PHYLUM CHORDATA. CLASS MAMMALIA
Order Cetacea

Family Balaenidae	Family Physeteridae	Family Balaenopteridae
<p>Right Whale <i>Balaena mysticetus</i></p> <p>Length to 70 ft., though 60 ft. is more common limit. Head $\frac{1}{3}$ length. Velvet black, gray, and white with a tinge of yellow, often with a little of upper jaw white. Older whales gray and white; younger, bluish-black; and very young, pale bluish-gray. Lower jaw shaped like a great U-shaped scoop.</p> <p>Essentially a northern form restricted to Arctic Ocean from Bering Sea, Baffin Bay, Davis Strait, and coast of Greenland. Primarily an open-sea animal. Probably never goes far from ice-covered regions. Now probably rarest of whales though it was formerly known as the common whale.</p> <p>Mates in summer and brings forth 1 or rarely 2 young 9-10 months later, in May. Nursing mothers are most commonly seen in spring. Care of mother for young is exemplary.</p> <p>Food, similar to that of blue whale, small organisms in open sea which are strained out and swallowed. This whale is mild-mannered and timid. It is less active and a slower swimmer than many of its associates and has therefore been more easily killed, particularly in the days of sailing vessels and hand-thrown harpoons.</p> <p>A right whale may yield 30 tons of oils. From 1715-1721, when this whale was pursued most vigorously, the Dutch paid $\frac{1}{2}$ million dollars for whalebone alone. Oil was used for lubrication and for oil lamps. Whale disappeared from Spitsbergen about 1720. One ship in search of these whales in 1912-1913 found none.</p>	<p>Sperm Whale, Cachalot <i>Physeter catodon</i></p> <p>Length to 60 ft. Weight to 60 tons. Tadpole-shaped, with long narrow sharp-toothed lower jaw. Head equals $\frac{1}{3}$ total length; greatest circumference at point where eyes and flippers are. Teeth on either side of lower jaw, 18-28, conical, sometimes over 8 in. long. No dorsal fin, but a dorsal ridge in male. Dark to black.</p> <p>Widely distributed over oceans of world from southern Africa to Japan and from Antarctic to Mediterranean. Moves with warmer ocean currents at different times of year. In 1935, it was taken in quantities in Antarctica, coast of Natal, Japan, British Columbia, Chili, and Newfoundland.</p> <p>Probably polygamous, 1-2 young being born 10-12 months after breeding. Young 12-14 ft. long at birth, and may reach a length of 18 ft. before teeth break gums, thus suggesting that animal is nursing. May double in length first year. Mother swims on side while she nurses her young.</p> <p>Food chiefly large squids or cuttlefish. One reliable record reports a 10-ft. shark intact in a sperm whale's stomach, so it probably could swallow a full-grown man whole. Breathes at surface about 10 minutes. Can swim at 12 knots.</p> <p>Blubber, in some places 14 in. thick, is valuable as source of oil. One whale may yield from the nose, 1 ton of spermaceti, a high-grade oil used in fabrics, cosmetics, and candles. Ambergris, useful in high-grade perfumes, comes from sick sperm whale. A 400-lb. mass of ambergris once brought over \$100,000. The whale should not be exterminated. Moby Dick was of this species.</p>	<p>Blue Whale, Rorqual <i>Balaenoptera musculus</i></p> <p>Largest animal that ever lived. Length to 109 ft. An 89-ft. whale was found to weigh 119 tons. Whalers figure 1 ton for every foot of length. Color slate blue. Head less than $\frac{1}{4}$ total length and not arched in front. Baleen plates in mouth, jet black. Dorsal fin small, $\frac{1}{4}$ body length, placed to rear.</p> <p>Has been taken from Iceland, Alaska, Japan, Kamchatka, Mexico, Chili, California, and South Africa, but now mostly from the Antarctic, which in 1935 produced 17,000, or nearly 94% of total supply of world. Migrates annually north and south.</p> <p>Breeding season long; in Antarctic, June-July. Probably monogamous. 1 young, weighing 7 tons, born 7-12 months after breeding. 90-ft. mother bears 23 ft. youngster, or rarely twins; nurses 12 months. At 1 year, 56-ft. female about 1 ft. longer than male. At 3 years, mature female, 77 ft. long. At 12-14 years, full-grown. Probably life span not over 50 years.</p> <p>Food almost exclusively shrimp-like animals which whalers call "krill." This occurs in great shoals through which whale swims, straining out food by opening mouth and then forcing water out through whalebone baleen, leaving food to be swallowed. Penguins, seals, fish, and whales thrive on this sort of food, which abounds in Antarctic.</p> <p>International agreements are necessary if industry dependent on whales is to be preserved. 1936 catch was 16,500 blue whales and 15,000 of all other kinds combined. Every probability that man will ruthlessly and foolishly ruin the industry for succeeding generations. Whalebone useless in animal under 53 ft. long.</p>

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